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How Clean Do You Want Your Streams: A Prospectus of Current Planning in Water Pollution Control for the Greater Houston Section 208 Area

Houston-Galveston Area Council, Tex

Prepared for

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May 77

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How Clean Do You Want Your Streams?

A Prospectus Of Current Planning In Water Pollution Control For The Greater Houston Section 208 Area

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An introduction to water quality standards and a presentation of the use of these standards in the current planning program of the H-GAC, namely the Greater Houston Areawide Waste Treatment Management Plan pursuant to the Federal Water Pollution Control Act Amendments of 1972, Section 208. These standards were derived with the assistance of citizen input obtained during a series of four public workshops held in January 1977 in various parts of the 208 planning area. It is not the purpose of this report to set specific water quality standards, that decision being reserved for a later stage of the planning process when the "cost and benefits" of attaining each of the various levels of water quality is known.

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H-GAC HOUSTON·GALVESTON AREA COUNCIL

EXECUTIVE SUMMARY

The following report is intended as an introduction to water quality standards and a presentation of the use of these standards in the current planning program of the Houston-Galveston Area Council (H-GAC), namely the Greater Houston Areawide Waste Treatment Management Plan pursuant to the Federal Water Pollution Control Act Amendments of 1972, Section 208.

The report is divided into four major subdivisions. The first is a brief description of the "208 Program" - its needs and directions. The second section includes a general explanation of standards for water quality in our streams and lakes - why clean water is desired and how the cleanliness of water can be measured. The third section presents the actual water quality measurements in our area streams and lakes. The final section presents the methodology to be employed in the Greater Houston "208 Program" which will evaluate the effects of obtaining each of these levels of resulting water quality.

The "208 Program" will develop alternative technical plans for the control of water pollutants. These alternative plans will result in varying levels of stream quality; that is, different plans will be developed which will achieve different levels of water cleanliness. This report presents three sets of water quality standards that will be used in the planning program.

These standards were derived with the assistance of citizen input obtained during a series of four public workshops held in January 1977 in various parts of the 208 planning area. These alternative water quality standards are presented in Table 4 at the end of this report.

It is not the purpose of this report to set specific water quality standards, that decision being reserved for a later stage of the planning process (in the fall of 1977) when the "cost and benefits" of attaining each of the various levels of water quality is known. The final selected plan, and the resulting standards will be submitted to the Texas Water Quality Board for certification and will, if certified, become the official policy of the State of Texas.

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HOW CLEAN DO YOU WANT YOUR STREAMS?

Prepared by

THE HOUSTON-GALVESTON AREA COUNCIL

in conjunction with

THE AREAWIDE WASTE TREATMENT MANAGEMENT PLAN FOR

THE GREATER HOUSTON AREA

(Section 208 of PL 92-500)

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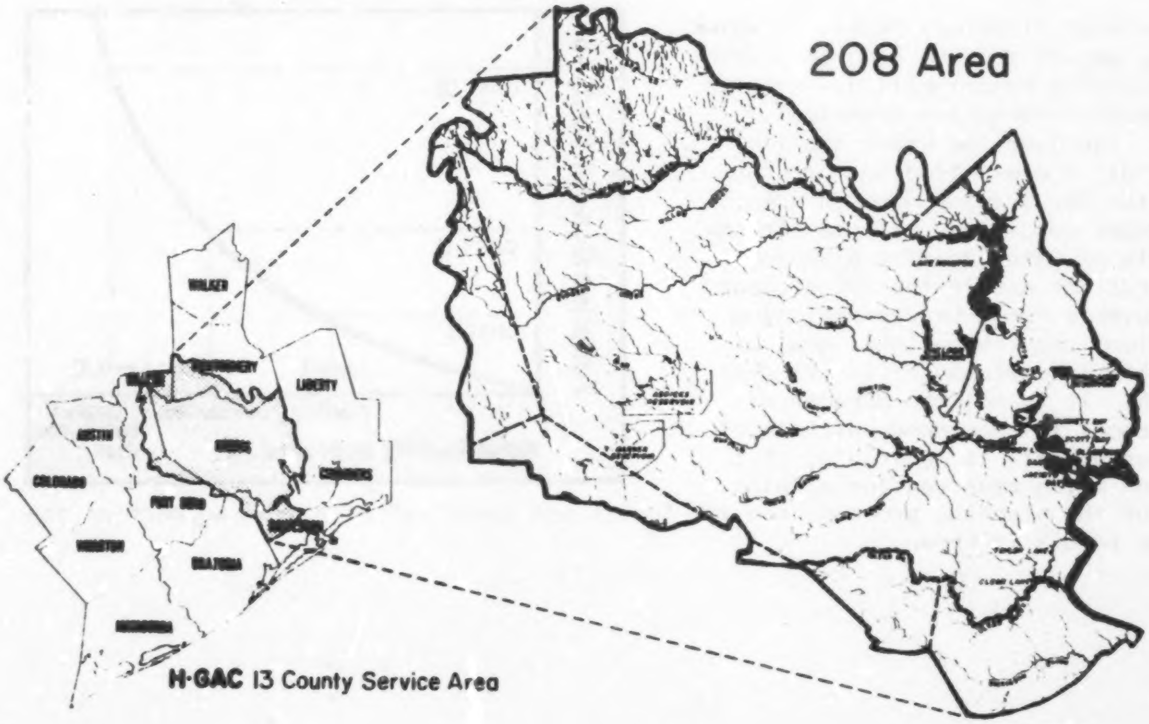
Introduction

The Federal Water Pollution Control Act Amendments of 1972 state that "...it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985" and that "..wherever attainable, an interim goal of water quality which provides for protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983...". Section 208 of that act provides for the development of Areawide Waste Treatment plans to achieve the national goals for clean water.

The Houston-Galveston Area Council received a grant of $1.8 million in June 1975 from the U. S. Environmental Protection Agency to prepare a comprehensive Areawide Waste Treatment Management Plan for the Greater Houston Area. The planning area, as designated by the Governor of the State of Texas, consists of all of Harris County and parts of five adjacent counties including Brazoria, Fort Bend, Waller, Galveston and Montgomery (Figure 1). This "Section 208" planning program, which is scheduled for completion in April, 1978, will analyze the effects of discharges of pollutants from municipal and industrial wastewater treatment plants (point sources) on surface water quality in the planning area. It will also assess the impacts of nonpoint sources of pollution such as stormwater runoff, septic tank drainage, and construction area erosion. One of the major outputs of this planning program will be the development of technical plans (e.g., construction of wastewater treatment facilities, stormwater pollution control facilities, and ordinances to

Figure 1



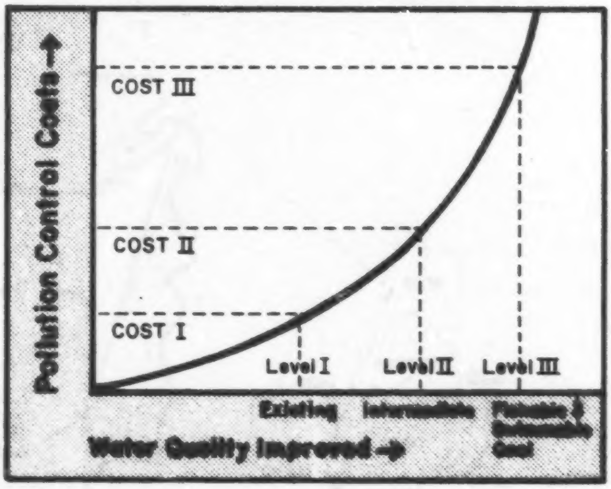
control nonpoint sources of pollution) which will achieve certain levels of water quality in area streams. Alternative plans will be drawn, costs will be determined, and impacts assessed for attaining several levels of water quality. This analysis will allow the determination of the financial, environmental, economic and social "costs" of achieving increasingly clean water in our area streams.

Common measures of the degree of water cleanliness take the form of water quality standards. Such standards express the chemical and physical conditions of streams, lakes, bays and estuaries as they exist or as the citizens of the areas think they should exist. The Texas Water Quality Board has adopted a set of standards for selected streams in the State. These standards, the latest version of which is dated February, 1976, are used for the issuance of discharge permits. The standards themselves are not legally enforceable. However, discharge permits are issued for release of waste materials to streams. These permits are written in such a way that the discharge, if within the permitted amount, will not violate the water quality standards for that stream. The permits, then, can be enforced thus theoretically insuring that the desired standards may be achieved.

This report is intended to work with existing Texas Water Quality Board standards as a baseline condition for water clean-up in our area and, further, to identify alternative levels of water quality that may be desired if the costs are reasonable and the impacts are beneficial. The costs and impacts of attaining these various levels of water quality will be determined by the 208 program. This information will then be used to support the preferred course of action for the various streams in our area. Figure 2 is presented as an illustration of the choices that must be made for each body of water. The added costs of achieving each improvement in water quality must be evaluated in terms of the citizens' ability to pay in light of the benefits of the cleaner water.

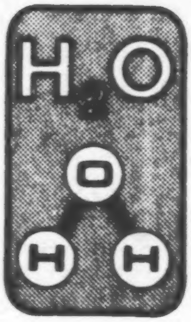
Figure 2

COSTS of ACHIEVING VARIOUS LEVELS of WATER QUALITY



But for what different levels of water quality should the 208 program plan? The following report will describe in both general terms and technical terms: the need for water quality standards; the existing set of standards for the Greater Houston Area; the actual conditions of area streams, and sets of water quality planning standards for use in the 208 program that cover a range between existing conditions and the national goal of "fishable and swimmable" in all area streams. It is not the purpose of this report to recommend which level of water quality is desirable, that decision being reserved for a later stage of the planning process when the "costs and benefits" of attaining each of the various levels is known.

What are water quality standards?



At some time everyone is taught that water is a chemical compound consisting of two atoms of hydrogen and one atom of oxygen. However, the water in our rivers and streams and even our faucets contains many substances in addition to the chemical compound we know as water. Clean water, though, does not necessarily mean pure water. In fact, many people would find "pure" water unpleasant to taste.

Fish and plants live in the water and contribute their wastes; refuse is dumped into the streams, and river bottoms contain sands and silts that mix with water. However, not all impurities are harmful; many are necessary to support aquatic life. Some potentially harmful substances are sufficiently diluted or cleansed by the water so as to be of little concern, while certain other pollutants can be tolerated at limited levels.

Water is considered polluted (unclean) when its condition is changed to the extent that it becomes less suitable for those uses which are acceptable in its natural state. This definition, although accurate, still leaves the question: How clean is clean? To assess what we really mean by clean water depends on where we are, what use we want to make of the environment, and the level of cleanliness for which we are willing to pay.

Why Do We Need Clean Water?

LIMITED
RESOURCES

Water is one of the most essential life sustaining elements on earth -- it is also a limited resource. The protection and conservation of our water supplies is, therefore, a matter of great importance.

Think for a moment about water as part of your everyday life -- water for drinking, cooking, personal hygiene, cleaning, lawn sprinkling, swimming; the list can go on and on. Now let us investigate some of the reasons why our water needs to be clean.

Public Health

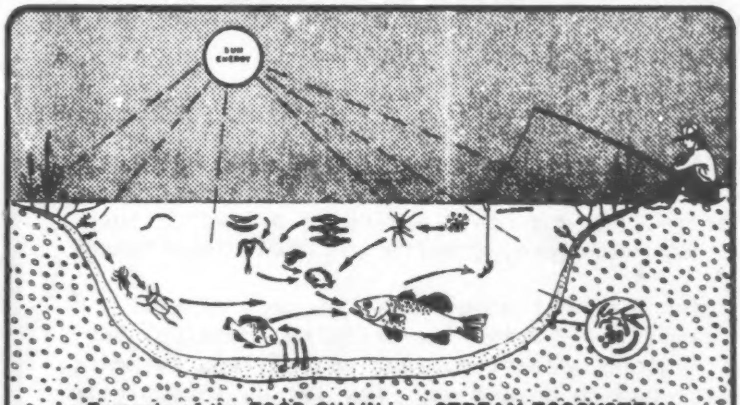
In the early part of this century, thousands of persons died from diseases such as typhoid, cholera, and dysentery. These epidemics were directly related to viruses and bacteria in water supplies that had been contaminated by the presence of sewage. Although modern sewage treatment methods have virtually eliminated these diseases, the presence of toxins (poisonous substances), viruses, and bacteria in water continue to cause disease incidents. From 1946 to 1970 more than 72,000 reported illnesses in this country were attributed to contaminated water, occurring primarily in rural areas from individual water supplies. The presence of viruses in untreated water has been implicated in epidemics of infectious hepatitis, polio, and intestinal disease. Outbreaks of infectious hepatitis and other sickness have also been attributed to the consumption of fish taken from contaminated waters. Mere physical contact with some polluted waters can at the very least cause skin irritations. The full range of long term effects of contaminants in the water is yet to be learned. But sufficient information exists to know that water borne disease must be a prime concern in a water study.

Food Production

In the H-GAC 13-county planning region, fishing is a significant economic as well as recreational activity. The effects of pollution on these activities can range from higher-priced seafood to a decrease in recreational facilities.

The coastal marshes and estuaries are spawning grounds for many shellfish and finfish of economic importance. Pollution of these waters has contributed to lesser production of this food source.

To understand the various effects of pollution on fish and marine life, it is necessary to look at the natural system of life in the water. The systems are complex, sensitive, and highly dependent on one another. An entire science (ecology) has come about in recent years to examine these relationships between organisms and their environment. Ecology studies have shown that for a system to sustain itself, it must be in balance, as illustrated by the food chain. The food chain in water begins with sunlight which is required for the growth of aquatic plants, such as algae and plankton. These plants are eaten by small fish which, in turn, become the food of other species of fish. The chain is completed, with the consumption of fish by humans. Due to these interrelationships, changes in the number or type of any one group of organisms will have carry-over effects on other parts of the system.



Example of the FOOD CHAIN in a STREAM ECOSYSTEM

Chemicals such as insecticides and pesticides and some metals can enter the food chain and become part of this life cycle. The following table portrays the increase in concentration of DDT as it is passed through the food chain.

Table 1

BUILDUP OF DDT IN FOOD CHAIN (I):

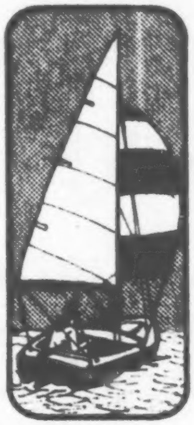
	DDT RESIDUES PARTS PER MILLION
Water	0.00005
Plankton	0.04
Silverside Minnow	0.23
Sheephead Minnow	0.94
Pickerel (predatory fish)	1.33
Needlefish (predatory fish)	2.07
Heron (feeds on small animals)	3.57
Tern (feeds on small animals)	3.91
Herring Gull (scavenger)	6.00
Fish Hawk (Osprey) egg	13.8
Merganser (fish-eating duck)	22.8
Cormorant (feeds on larger fish)	26.4

The growth of aquatic plant life is also related to the availability of minerals, such as phosphates and nitrates. An overabundance of these minerals, such as that resulting from runoff from fertilized agricultural lands, causes excessive growth of vegetation (eutrophication). More plants provide a greater food supply for aquatic life. However, too many plants result in the uptake of too much oxygen from the water, thereby choking off higher forms of marine life.

Higher than normal increases in water temperature can also affect the life activities of many fish. Shellfish and trout are particularly sensitive to even minor temperature increases. Heating can also alter the natural plant life in water, further disrupting the delicate balance. Thermal pollution can result from the discharge of waters that have been used in power plant and industrial cooling.

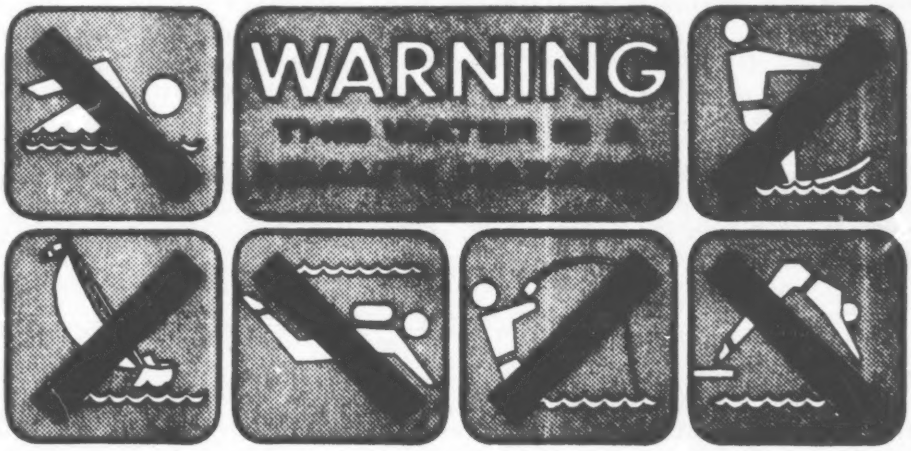
Recreation/Aesthetics

Other activities that have a bearing on water quality improvement are recreation and aesthetics. Swimming, boating and fishing are among the most popular outdoor activities in the Houston area.



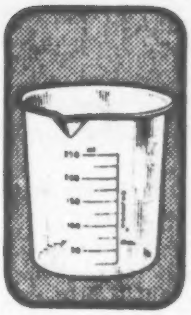
For the purpose of water quality classifications, these activities are defined by the amount of physical contact the participant has with the water. Contact sports are those where there is prolonged, intimate contact with water (such as swimming and water skiing) involving the possibility of swallowing some untreated water. Non-contact sports are those where actual bodily contact is incidental, such as fishing or boating. Health considerations are an obvious concern for the quality of water involving contact recreation. Less obvious; perhaps, are safety hazards which may arise from excessive vegetation clogging boat engines, oil spills, or turbidity (cloudiness of water) decreasing underwater visibility.

Aesthetic considerations include the enjoyment of a picnic by a flowing stream and the beauty of a scenic lake. These pleasures are important values to many citizens. Unsightly wastes and odors interfere with the enjoyment of our natural resources.



What Determines The Cleanliness of Water?

The human senses of sight, smell, and taste can give important clues as to the suitability of water. However, the senses can fall far short of fully describing the problem. A glass of water may be clear, odorless and tasteless and still contain toxic materials or undesirable bacteria. On the other hand, unsightly trash floating on the water, while aesthetically displeasing, might not be absorbed by the water and affect its usability.



Scientific techniques have been developed to measure the many types of foreign substances in water. The tests for pollutants can be divided into four general categories:

1. CHEMICAL POLLUTION -- organic and inorganic compounds such as phosphates, nitrates and chlorides.
2. PHYSICAL POLLUTION -- characterized by color, foaming, cloudiness and temperature.
3. BIOLOGICAL POLLUTION -- characterized by the presence of bacteria and viruses.
4. PHYSIOLOGICAL POLLUTION -- characterized by extensive growth of algae.

The cleanliness (or quality) of water requires measurement in numerical values to allow for its healthful and appropriate use.

What Are Water Quality Standards?

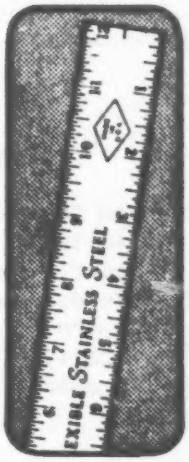
Water quality standards are the numerical values that guide what we may or may not add to the water. We can control most direct discharges and require that they conform to standards which will provide reasonable protection of water quality. However, there are pollution sources which are, at best, difficult to control, such as storm runoff from urban and agricultural areas.

Standards are designed to allow the most appropriate uses of the water while protecting the health, safety and well-being of persons and the environment. There are various uses for the different bodies of water and, as we have seen, these uses require varying levels of cleanliness. Standards must therefore be developed for each type of use desired for each waterway.

The process of setting standards begins with research and monitoring to ascertain the nature of the pollutants and to determine appropriate testing measures. Setting standards is a continuing process; as further knowledge is acquired or as water uses change, standards are modified accordingly.

What Are Measures of Clean Water?

Measurement Units

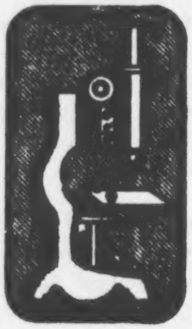


A discussion of measurements of the quality of water must be preceded by a discussion of the common units of measurement. The most commonly used measurement of water quality is the concentration of a contaminant, expressed in milligrams per liter (mg/l). In water, one milligram per liter is roughly equivalent to one part per million (PPM). Therefore one milligram per liter of salt is equal to one gallon of salt in one million gallons of water. Sea water normally contains 20,000 mg/l or PPM of chlorides. Often small concentrations are expressed as micrograms per liter (μg/l), a microgram being one-onethousandth (1/1000) of a milligram.

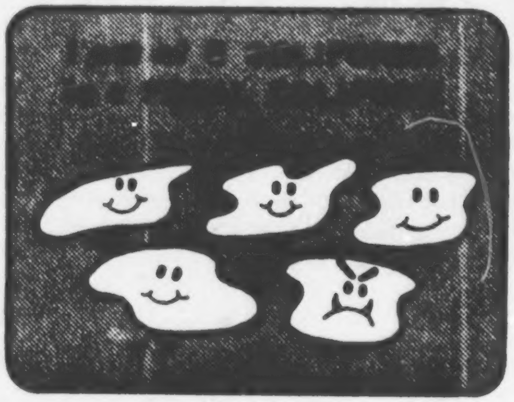
Bacterial concentrations are measured in MPN per 100 milliliters (MPN/100 ml), which is a statistical measure of the Most Probable Number of bacteria likely to be found in 100 ml of water.

Bacteria

Probably the most important aspect of stream quality with regard to human health is the bacteriological concentration. A liter of water from a typical stream in this area will contain literally millions of various types of bacteria. Despite the "bad press" which bacteria receive, however, streams would not be "healthy" without many of them. The vast majority of these bacteria are beneficial to streams in that they form the basis of the food chain for higher organisms. Many of the bacteria in streams help to decompose wastes, either natural or man-made, found or deposited in streams.



Laboratory analysis of specific bacteria or viruses is a long, difficult process, depending upon the type of bacteria for which one is looking and often requires highly-trained personnel. For this reason, a bacteriological analysis of water samples in streams does not generally involve determining all the types of organisms present. Instead, one attempts to quantify certain bacteria which are found in areas having sewerage pollution and may, therefore, contain disease-causing organisms called pathogens.



Since there are a great variety of pathogens and the tests to determine their presence are difficult, it has been mandatory to develop a measure which is indicative of the presence of pathogenic organisms. The most common indicator is the general group of bacteria called coliform. A measurement of total coliform includes the entire group. Fecal coliform, a specific member of the group, are found in the intestines of all warm-blooded animals. In water quality applications, a sample of total coliform generally contains approximately 20 percent fecal coliform. The presence of fecal coliforms is indicative of probable pollution from domestic sewage and these organisms are called indicator species. Fecal coliforms, by themselves, are not harmful to man and exist, literally by the billions, within each person's digestive tract. By analyzing for fecal coliforms, one can get an indication of areas where there exists the possibility of the presence of pathogens (disease-causing organisms), which accompany fecal coliform via domestic sewage into streams. In some cases, however, these pathogens may outlive the more common fecal coliforms and, therefore, the use of any indicator species should be used with caution in estimating the biological safety of surface waters.

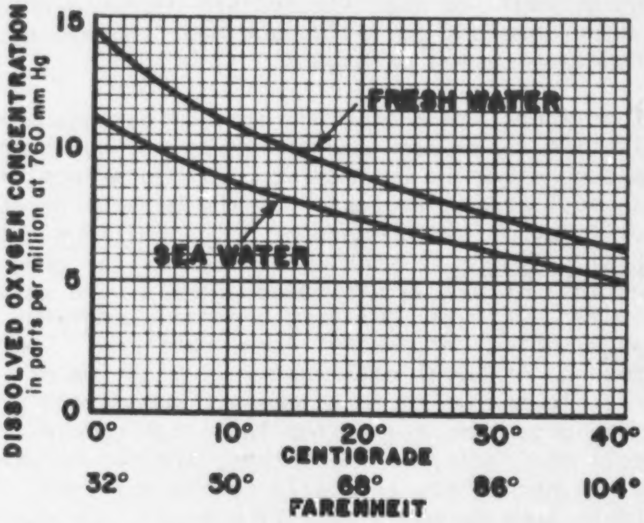
Some studies have indicated that in samples containing between 200 to 2000 MPN/100 ml of fecal coliform or greater, the presence of Salmonella (a bacteria generally associated with typhoid fever) was detected in almost 100 percent of the samples. (2) The incidence of Salmonella decreases sharply in samples with a low concentration of fecal coliforms. At the 200 MPN/100 ml fecal coliform level, the Salmonella occurance was at 28.4 percent, and at the 29 MPN/100 ml fecal coliform or less range, this percentage dropped to 4.7.(2) Total coliform density for shellfish harvesting water has been set, by international agreement, at 70 MPN/100 ml. For domestic raw water supply (to be treated for drinking water), it is desirable that the total coliform count not exceed 100 MPN/100 ml and that the fecal coliform count not exceed 20 MPN/100 ml.

Dissolved Oxygen

Oxygen which is dissolved in water is in the same form (O_2) as it exists in the atmosphere. Dissolved oxygen (DO) plays an extremely important role in natural streams, being necessary for the respiration of aquatic life, both plant and animal. Therefore dissolved oxygen in streams and lakes is necessary for protection and propagation of fish, shellfish, and associated wildlife.

There is a limit to the amount of oxygen that can be dissolved in water. The maximum concentration (saturation level) in water is dependent upon a number of factors including temperature and salinity. This relationship is illustrated in the following figure.

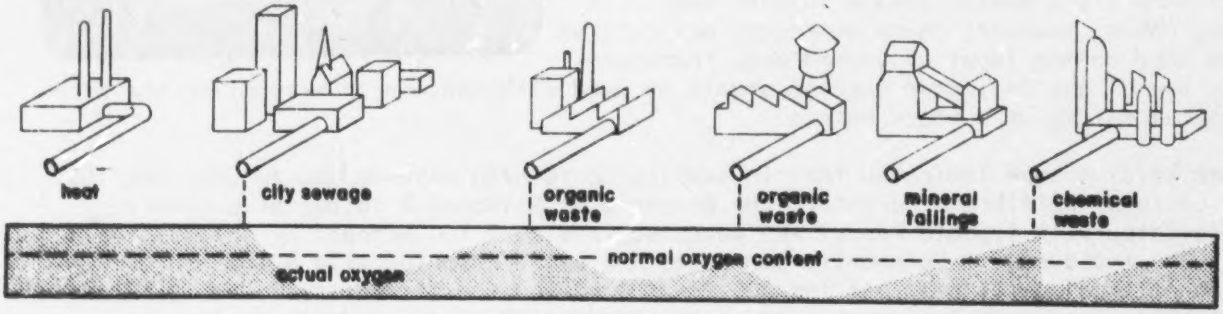
Figure 3



The actual concentration of oxygen in a particular body of water is dependent upon saturation level, turbulence, depth, the presence of aquatic plants and algae, and the presence of organic matter.

As a water quality concern, the lack of dissolved oxygen is a problem. Excessive levels of organic material introduced into a stream or lake will cause the dissolved oxygen to be used up, sometimes faster than it can be replaced from the atmosphere. Organic matter can be introduced through natural mechanism (e.g., decomposing leaves) or through discharge of wastes from treatment plants (domestic sewage and industrial wastes). The result of the fluctuation in oxygen resources due to organic material introduction is termed an oxygen sag and is illustrated in the following figure.(3)

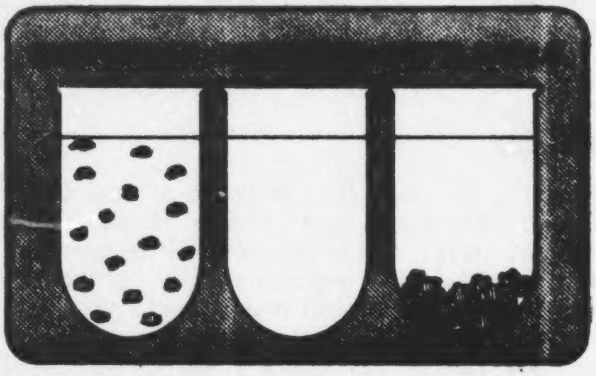
Figure 4



The amount of organic material is commonly measured in terms of the amount of oxygen which is used up in the decomposition of that material. This measurement is called Biochemical Oxygen Demand (BOD) and is expressed as the concentration of oxygen removed in milligrams per liter.

The amount of dissolved oxygen which must be present to support fish and wildlife propagation is dependent upon the type of fish and is the subject of some controversy. In general, fish whose natural movements are sluggish, such as carp, and gar are more tolerent of low dissolved oxygen than fish whose movements are more rapid, such as perch and sunfish. The EPA recommends that the minimum concentration of dissolved oxygen to maintain a healthy, varied fish population is 5.0 mg/l. During a 24-hour period, oxygen concentration should never fall below 3.0 mg/l.

Suspended and Dissolved Solids



Solids in water take two forms, suspended and dissolved. Suspended solids are such things as plant fibers and dust particles in water, while dissolved solids are like sugar in coffee. Most solids in water are the result of wash-off from vacant areas, agricultural lands, and urban areas. As rainwater flows from these areas, certain amounts of soil, plant material and accumulated dust washes into and is suspended or dissolved in streams. This water may also dissolve materials from the surface of the land. The amount of suspended solids and the constituents within dissolved solids depend largely upon the makeup of the soil over which it flows.

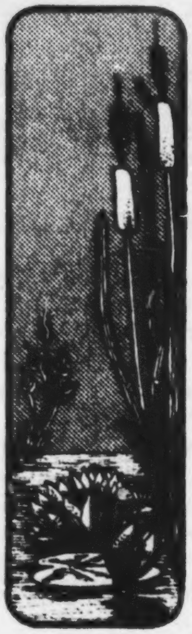
Dissolved solids are an important criteria with regard to the use of water sources as a domestic or industrial water supply. A concentration of less than 500 mg/l of dissolved solids is generally accepted as good for domestic water supply, although actual human tolerances can be somewhat higher than this with no harmful effects.(4) The limitation on dissolved solids for industrial users is heavily dependent upon the use to which the water will be put. Water used in boilers, for example, should often be as low as 50 mg/l, depending upon the pressure, in order to avoid foaming and depositions on the sides of the boiler.(4)

The tolerance of fish to solids is extremely varied, depending upon the species of fish, time of acclimation, type of solids and a number of other factors. In aquatic habitats, suspended matter can cause abrasive injuries and interfere with respiration in fish. Solids also settle to stream bottom, covering fish eggs and smothering benthic or bottom dwelling organisms. Studies have indicated that inert solids at concentrations greater than 100 mg/l eliminated some fish species and 80 mg/l decreased the density of bottom dwelling organisms substantially.

Nutrients

Nutrients are necessary to the growth of plants in all bodies of water. The major nutrients involved in plant growth are compounds of nitrogen, phosphorus, and trace minerals. These compounds occur naturally and are found in streams both affected and unaffected by man. Man-made nutrient sources include runoff of excess fertilizer from urban and agricultural areas and point sources such as municipal and industrial wastewater treatment plant outfalls.

Although some nitrogen compounds such as ammonia and nitrites are considered poisonous in sufficient quantities, most aquatic scientists agree that the direct toxic effect of natural nitrogen and phosphorus compounds are not as great a problem as the indirectly caused problem of eutrophication (the excessive growth of aquatic plants due to over-fertilization by nutrients).



There is no general agreement on the quantities of nutrients causing eutrophication. Rather, it involves a large set of chemicals, reacting in a complex set of conditions that triggers the overgrowth of aquatic plants. Other conditions which may have a bearing upon the onset of eutrophication include pH, temperature, and the specific types of plants available. Most studies agree, however, that the overabundance of nitrogen or phosphorus is a major cause of eutrophication, probably in concentrations of greater than 0.3 mg/l and 0.01 mg/l, respectively. (4)

Salinity

Salinity is usually a measure of the chloride (salt) concentration in water. All lakes and streams contain some chloride and, of course, oceans, bays, and estuaries normally contain much higher concentrations of chlorides. Chlorides may be introducted into a stream in a natural manner (water passing over a salt deposit) or as a result of man's activities (runoff from agricultural lands, oil fields, and from domestic and industrial waste treatment plants).

Chloride in lakes and streams poses problems when the water is to be used for raw water supply. Chlorides in concentrations of up to 100 mg/l are suitable for drinking water and the U. S. Public Health Standards set the maximum allowable level at 250 mg/l. Chloride in industrial water supply may cause problems due to the corrosive properties of the salts.

Salinity requirements for fish and wildlife also vary considerably. Marine and estuarine species seem to have higher limits of tolerance than freshwater fish. However, there is insufficient data to adequately quantify tolerable concentration levels. Therefore introduction of high concentrations of chlorides into a fresh water system could pose problems for the normally found fish species.

Pesticides and Chlorine

Pesticides are toxic chemicals utilized for the control of insects, rodents, bacteria, fungi, and plant life. Pesticides usually find their way into streams and waterways by washing off agricultural and urban lands which have received a dosage of the pesticide. While some pesticides readily degrade after a short period in waters, others are quite persistent after long periods in the environment and may even chemically change to a more toxic substance.

Taking all factors into account, the EPA has suggested standards for some of the more common pesticides for freshwater and marine aquatic life as well as for human consumption.(2)

Chlorine, although dissipated rapidly in the environment and reported not as harmful to humans in concentrations up to 50 mg/l, is highly toxic to fish and wildlife. (4) Chlorine is the most widely used disinfectant in domestic waste treatment plant operations and can be considered a pesticide. Near sewerage outfalls and for long distances in small streams receiving a number of discharges, chlorine concentrations are often excessive. Chlorine in concentrations from 0.09 to 0.3 mg/l have been recorded as lethal doses for "rough" fish as well as sensitive aquatic organisms. The EPA has suggested a limit of 0.01 mg/l for warm-water fish.(2)

Table 2

PESTICIDES STANDARDS, $\mu g/l$

	FRESHWATER AQUATIC LIFE	MARINE AQUATIC LIFE	HUMAN CONSUMPTION
Aldrin-Dieldrin	.003	.003	Minimum Exposure*
Chlordane	.01	.004	Minimum Exposure
2, 4-D	Not Given	Not Given	100.
DDT	.001	.001	Minimum Exposure
Endrin	.004	.004	.2
Heptachlor	.001	.001	Minimum Exposure
Lindane	.004	.01	4.0
Malathion	.1	.1	None Given
Toxaphone	.005	.005	5.

*Human exposure should be kept to the absolute minimum

Oil and Grease

Washoff from oil fields, urban runoff, storm drainage from commercial garages and parking lots, wastes from restaurants, and accidental spills from ships and pipeline breaks are all important sources of oil and grease in the aquatic environment. Within streams and lakes, oil and grease can accumulate in the sediment and form floating films upon the surface of the water. The composition of these materials is highly varied, including animal fat, soluble hydrocarbons, kerosene, crude oil, gasoline, lubricants, and diesel fuel. Certain concentrations of some of these oil and grease compounds are directly toxic to man as well as wildlife populations. However, probably more organisms are harmed as a result of the interference of these substances with respiration and long term disruption of life cycles in terms of feeding and reproduction.

It is difficult to place numerical criteria on petroleum products due to the variability in toxicity. However, toxicity levels of approximately 0.1 mg/l are generally accepted for marine crustaceans and disruption of cellular and physiological processes can occur at levels of 0.01 or 0.1 mg/l.

Metals

Various types of metals in both elemental and compound forms occur naturally in waterways. Humans, animals and plants have nutritional needs for specific metals in their daily diet up to a specific maximum concentration level and exceeding this level can cause serious physiological disturbances and even death.

The problem that must be assessed is not the naturally occurring concentrations of metals in the waterways, but the amounts that are being added through industrial waste discharge and urban runoff. Extrapolations from recent studies (2) indicate that nationally as much as 5000 tons of lead per year may be added to the aquatic environment as a result of urban runoff.

The following table presents recommended standards for concentration of various heavy metals.(2)

Table 3

HEAVY METAL STANDARDS, mg/l

	FRESHWATER AQUATIC LIFE	MARINE AQUATIC LIFE	HUMAN CONSUMPTION
Lead	0.03	0.5	0.05
Cadmium	0.0004	0.005	0.01
Manganese	1.5	0.1	0.05
Chromium	0.1	1.0	
Barium	50.		1.0
Mercury	0.00005	0.0001	0.002
Cyanide	0.005	0.005	10.0
Silver	0.0003	0.0003	0.05
Selenium	1.5		0.01
Zinc	0.1	0.1	5.0
Arsenic	0.05	0.05	0.05
Copper	0.036	0.6	1.0
Nickle	0.1	0.1	

How do Houston area streams measure up?

Introduction to Current Standards

The report entitled "Water Quality Standards" is a current revision of "Water Quality Requirements" developed by the Texas Water Quality Board staff early in 1967, by the authority of Vernons Texas Code Annotated, Water Code, Sections 21.075 through 21.078. These standards, adopted by the Board February 1976 represent closer compliance to the water quality requirements designated by the Federal Water Pollution Control Act Amendments of 1972. A final major revision should occur by 1978, in order to meet the Environmental Protection Agency goals of 1983, which states that the waterways of this nation shall be of such quality that they will support fish and wildlife and be suitable for contact recreational activities.

The standards are divided into three parts: general criteria, numerical criteria, and surface water usage criteria.

The general criteria are applicable to all surface waters of this state wherever and whenever feasible and with specific respect to substances attributed to waste dishcarges, such as taste and odor producing substances, floating debris, persistent foaming and frothing substances, and radioactive materials in excess of that amount regulated by the Texas Radiation Control Act. And, it further requires that the streams shall be maintained in an aesthetically attractive condition.

The numerical criteria apply to the waters identified with established standards and specifically apply to substances attributed to waste discharges resulting from people-related activities. The numerical criteria define values for parameters such as maximum temperature range, chlorides and sulfates, pH range the minimum amount of dissolved oxygen necessary to support aquatic life, and fecal or total coliform content.

Water usage criteria define the standards desirable for particular usage of specified surface waters. There are four categories of usage: contact recreation, noncontact recreation, domestic raw water supply, and waters for propagation of fish and wildlife.

Surface water designated suitable for contact recreation shall not exceed 200 MPN/100 Ml fecal coliform content in not less than five samples collected over not more than thirty (30) days, nor shall more than 10 percent of the total samples collected during any 30-day period exceed MPN/100 ml.

Surface waters suitable for general or noncontact recreation (activities not involving significant risk of ingestion) shall have no more than 2,000 MPN/100 ml fecal coliform content, and neither equal to nor exceeding 4,000 MPN/100 ml in more than 10 percent of the samples with limited and specified exceptions set by the Texas Water Quality Board.

Domestic raw water supply quality should be consistent with the findings of the Environmental Protection Agency regarding maximum contaminants and treatment techniques. However, though it is desirable that the total coliform content should not exceed 100 MPN/100 ml and the fecal coliform content 20 MPN/100 ml, domestic water supplies shall not be considered unacceptable if an adequate number of samples show arithmetic averages for the total coliform to be less than 10,000 MPN/100 ml, and fecal coliform less than 2,000 MPN/100 ml and that chemical constituents do not pose a potential health hazard.

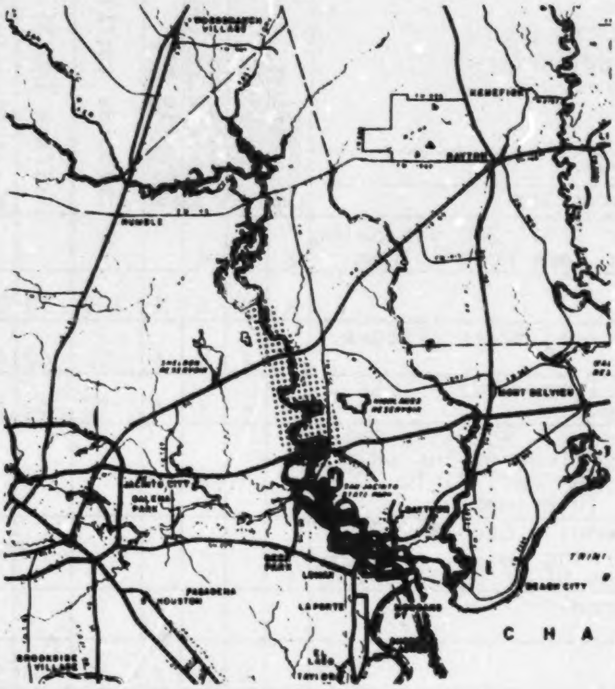
Water quality standards supportive of fish propagation and wildlife must consider the widely differing requirements of the biological community present in each stream as well as the physical and chemical parameters. It is, therefore, not possible to construct a single set of numerical criteria applicable to all waterways. However, specific criteria of 70 MPN/100 ml of total coliform for shellfish waters are set by the U. S. Public Health Service.

The following tables represent the current (February, 1976) Water Quality Standards for Houston area streams.

SAN JACINTO RIVER BASIN (Fresh and Tidal Waters)		WATER USES DEEMED DESIRABLE				CRITERIA						
SEGMENT No.	Description	Contact Recreation	Noncontact Recreation	Propagation of Fish & Wildlife	Domestic Raw Water Supply	Chloride (mg/1)	Sulfate (mg/1)	Total Dissolved Solids (mg/1)	Dissolved Oxygen (mg/1)	pH Range	Fecal Coliform (100 ml)	Temperature °F
1001	San Jacinto River Tidal 200 yds below I.H. 10 Bridge to Lake Houston Dam	X	X	X					4.0	6.5-8.5	200	95
1002	Lake Houston	X	X	X	X	100	50	200	5.0	6.5-8.5	200	90
1003	East Fork San Jacinto River - above Lake Houston		X	X	X	80	40	400	5.0	6.5-8.5	2,000	91
1004	West Fork San Jacinto River - Lake Houston to Conroe Dam	X	X	X	X	80	40	300	5.0	6.5-8.5	200	95
1005	Houston Ship Channel - Morgan's Point to San Jac. R. confluence, including tidal portion of San Jac. R. to 200 yards below I.H. 10 Bridge		X	X					4.0	6.0-8.5	1,000	95
1006	Houston Ship Channel - San Jac. R. confluence to Turning Basin, including tidal portions of tributaries.								2.0	6.0-8.5	2,000	95
1007	Houston Ship Channel - Turning Basin								1.5	6.0-8.5	2,000	95
1008	Spring Creek		X	X	X	80	40	300	5.0	6.5-8.5	2,000	90
1009	Cypress Creek		X	X	X	80	40	300	5.0	6.5-8.5	2,000	90
1101	Clear Creek Tidal		X	X					4.0	6.5-9.0	2,000	95
1102	Clear Creek - above tidal		X	X		200	100	600	5.0	6.5-8.5	2,000	95
1103	Dickinson Bayou Tidal	X	X	X					4.0	6.5-9.0	200	95
1104	Dickinson Bayou - above tidal		X	X		200	100	600	5.0	6.5-8.5	2,000	90
TRINITY-SAN JACINTO ESTUARY (Bay & Gulf Waters)												
2425	Clear Lake	X	X	X					4.0	6.5-9.0	200	95
2426	Tabbs Bay	X	X	X					4.0	6.5-8.5	200	95
2427	San Jacinto Bay	X	X	X					4.0	6.5-8.5	200	95
2428	Black Duck Bay	X	X	X					4.0	6.5-8.5	200	95
2429	Scott Bay	X	X	X					4.0	6.5-8.5	200	95
2430	Burnett Bay	X	X	X					4.0	6.5-8.5	200	95

Current Standards and Existing Water Quality in Area Streams

The following is a description of the streams and bayous comprising the San Jacinto River and Brazos Coastal Basin area that lies within the jurisdiction of Section 208 planning. The Texas Water Quality Standards have divided each river and coastal basin into segments which exhibit characteristics significantly different from those of adjacent segments. Each segment is classified on the basis of instream quality as compared to the Water Quality Standards and then ranked according to problem severity.

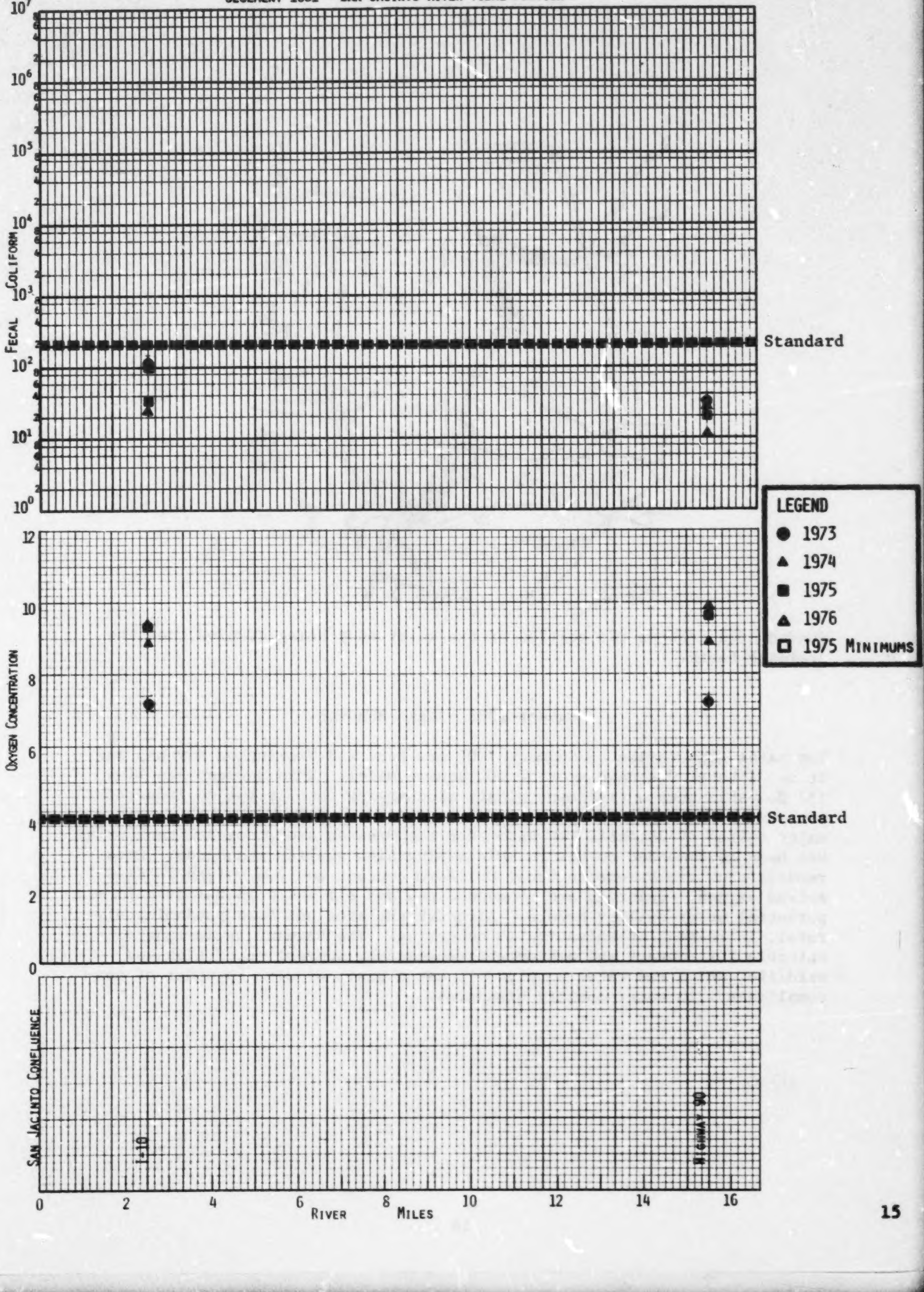


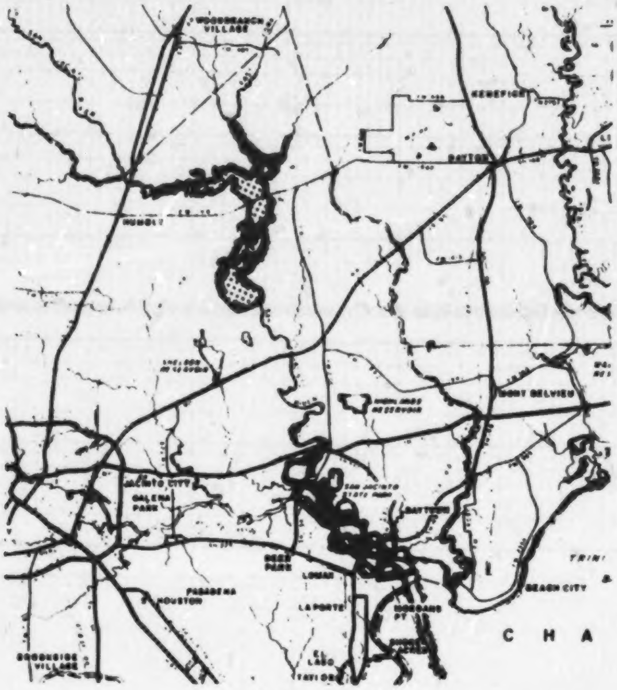
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1001 - San Jacinto River

Segment 1001 is located from 200 yards below I-H 10 Bridge to the Lake Houston Dam sixteen miles northeast of downtown Houston. It is 20.2 miles in length and drains an area of 62 square miles. There are several residential communities in this area, with some industrialization and no major agricultural activity. However, this segment is used extensively for contact recreation. The major tributaries are Jackson Bayou and Granite Spring Creek. Sources of discharge into this segment are seven domestic sewage treatment plants, of which two are operating beyond capacity, and four industrial operations. In addition, the water quality is also influenced by tidal action mixing with the Houston Ship Channel. Routine monitoring by the Texas Water Quality Board shows violations in fecal coliform and dissolved solids. The basin rank is seventh in order of noncompliance with quality standards. It is designated as suitable for contact and noncontact recreation and supportive of fish and wildlife.

SEGEMENT 1001 - SAN JACINTO RIVER TIDAL PORTION



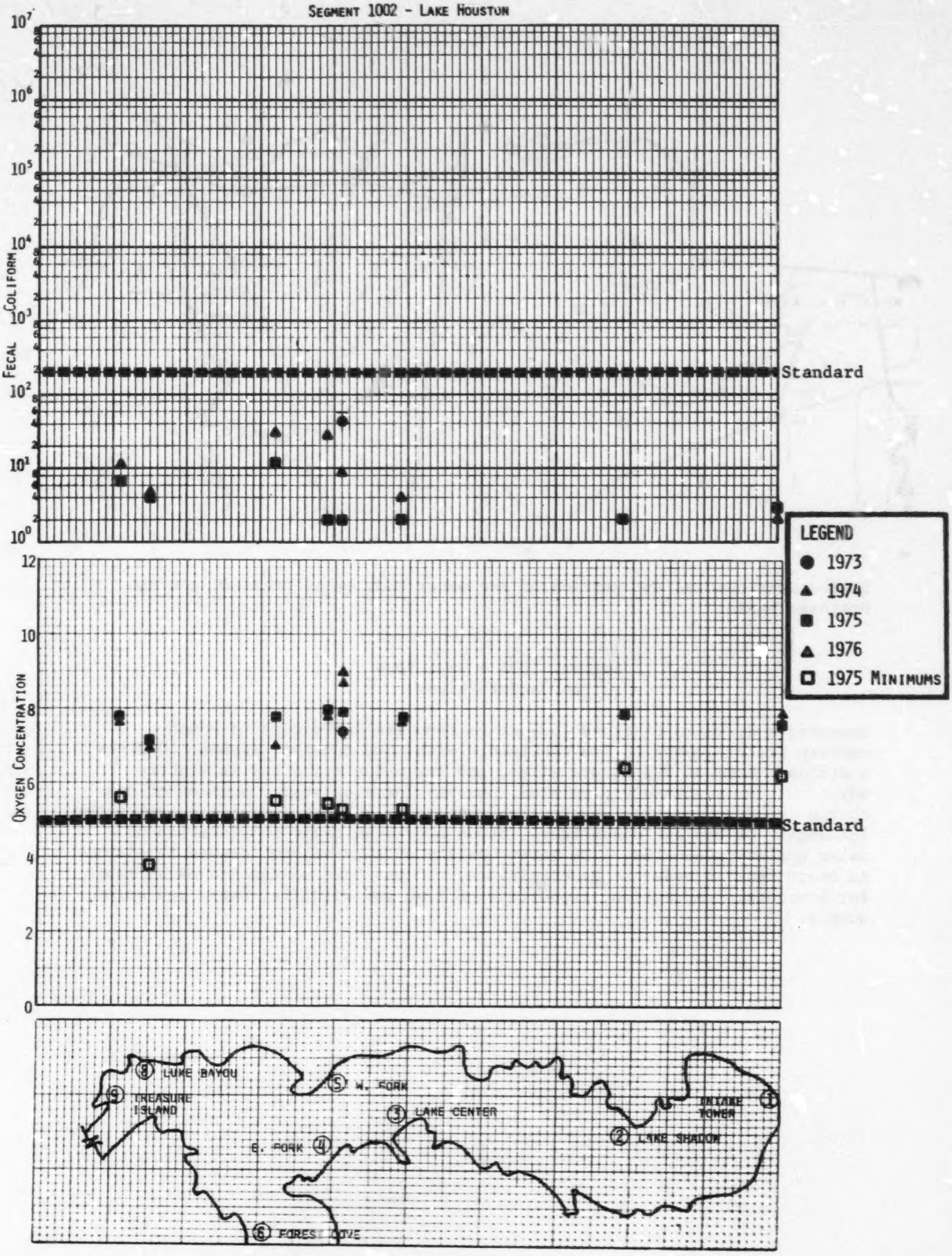

WOODBRANCH VILLAGE
HUMBLE
HIGHLANDS RESERVOIR
MONT BELVIEU
BAYTOWN
JACINTO CITY
GALENA PARK
SAN JACINTO STATE PARK
DEER PARK
LOMAX
LAPORTE
PASADENA
S. HOUSTON
MORGANS PT
BEACH CITY
C H A

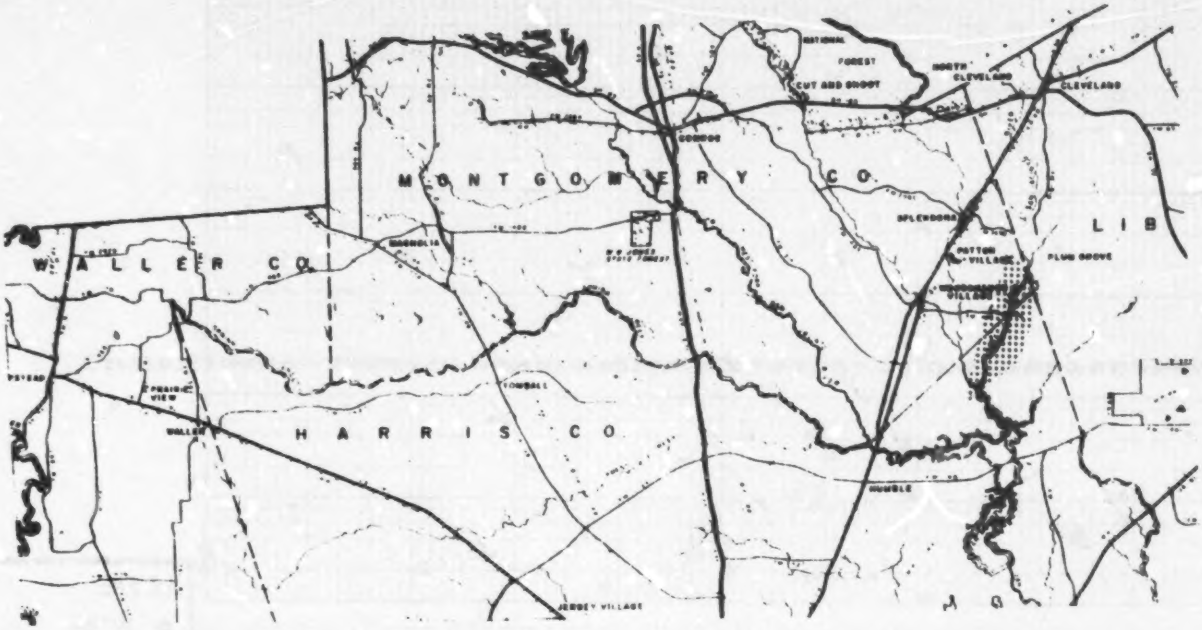
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1002 - Lake Houston

The major tributaries to Segment 1002 are Luce and Tarkington Bayous, and it has a total drainage area of 300 square miles. This segment has five (5) domestic sewage treatment plants discharging into it but no industrial wastewater loadings and agricultural activities. Since Lake Houston is a major source of domestic raw water for the Houston area, special monitoring has been recommended to aid in maintaining high quality standards. Data records show violations in fecal coliform content and low values in dissolved oxygen. Existing and abandoned gas and oil wells in the area form a potential water quality hazard. Although the area has been predominately rural, increasing urbanization is occurring. The Segment is designated suitable for contact and noncontact recreation, supportive of fish and wildlife, and a raw water supply. It has a basin of 24th in order of noncompliance with water quality standards.

SEGMENT 1002 - LAKE HOUSTON



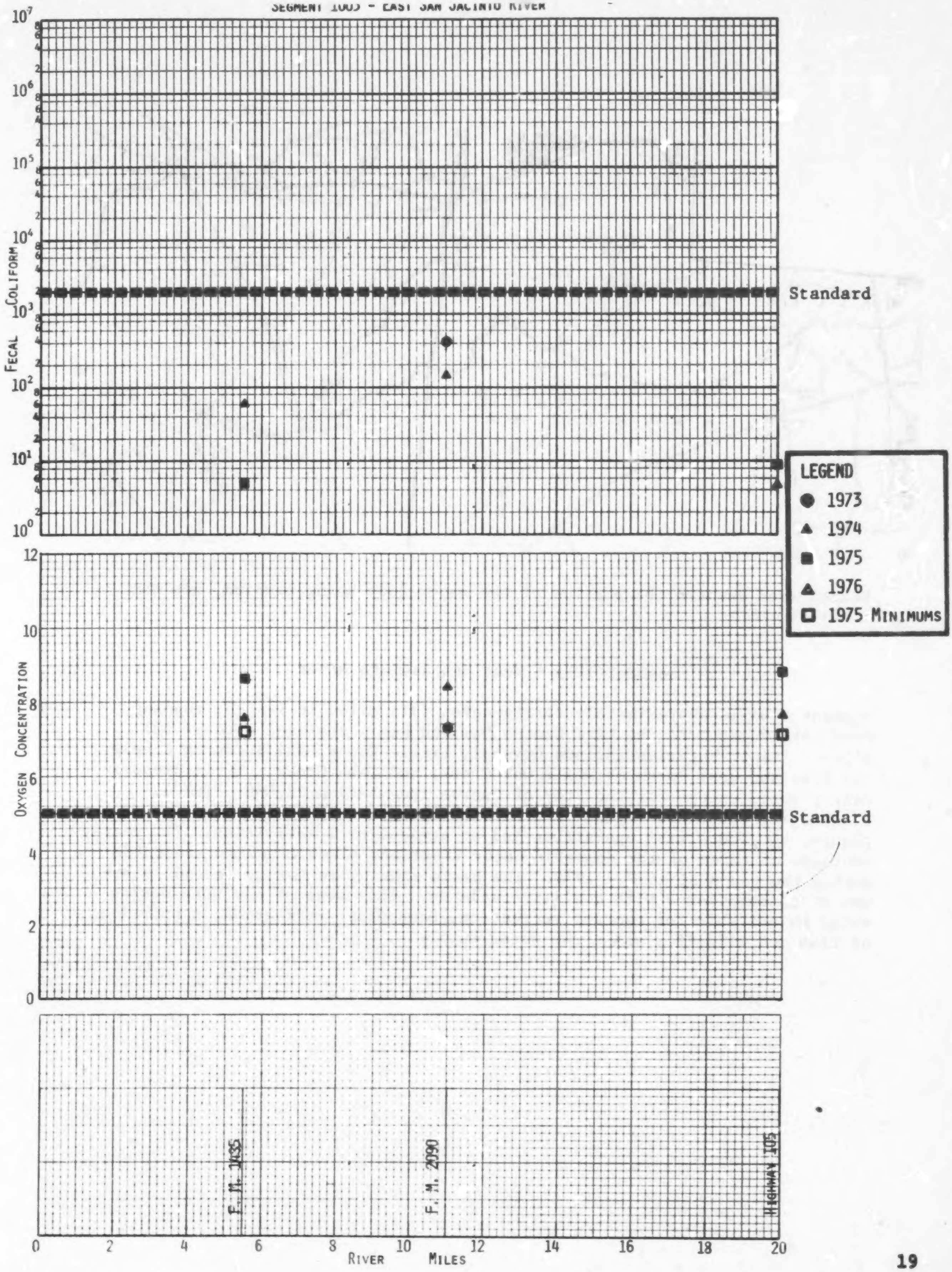

NATIONAL
FOREST
CUT AND SHOOT
NORTH CLEVELAND
CLEVELAND
CONROE
M O N T G O M E R Y C O.
SPLENDORA
L I B
PATTON VILLAGE
PLUM GROVE
MAGNOLIA
W. W. JONES STATE FOREST
W A L L E R C O.
PRAIRIE VIEW
TOMBALL
WALLER
H A R R I S C O.
HUMBLE
JERSEY VILLAGE

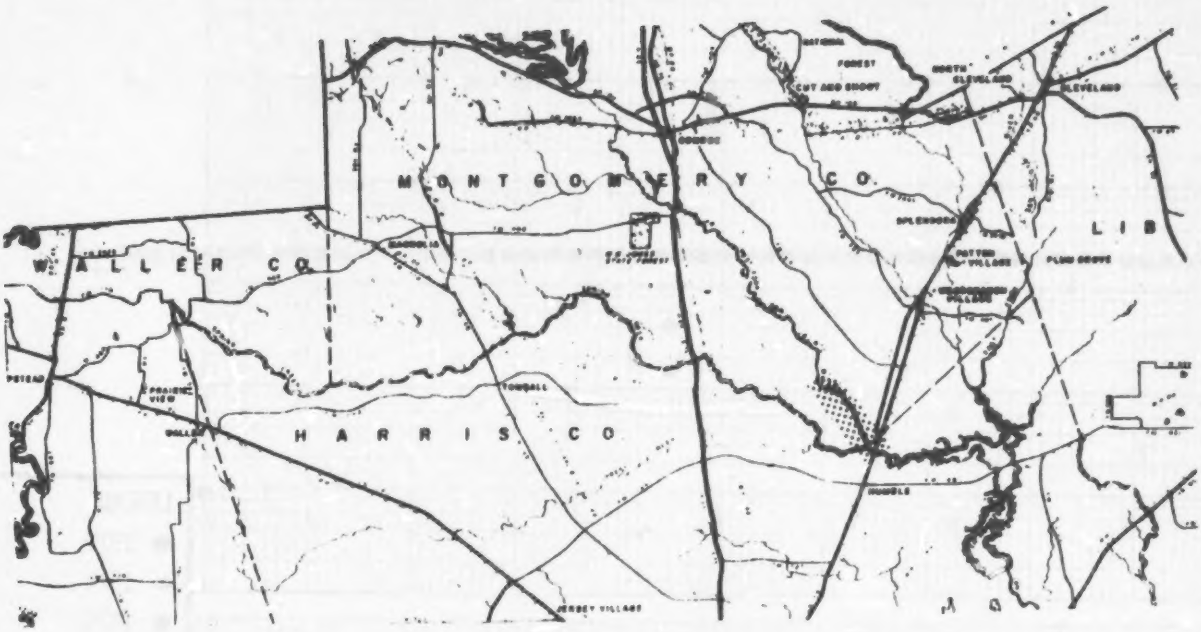
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1003 - East Fork
San Jacinto River

Spanning a distance of fifty (50) miles from its headwaters in southeastern Walker County to its confluence with Lake Houston, Segment 1003 has a drainage area of 398 square miles, and its major tributary is Winters Bayou. It is a sparsely populated, heavily forested area. Sources of discharge are four domestic sewage treatment plans and two industrial wastewater loadings. Of the six dischargers, three have been found in violation of water quality standards. The water quality of this segment places it sixth in basin rank in order of noncompliance. It has been designated as suitable for noncontact recreation, supportive of fish and wildlife, and a raw water supply.

SEGMENT 1003 - EAST SAN JACINTO RIVER



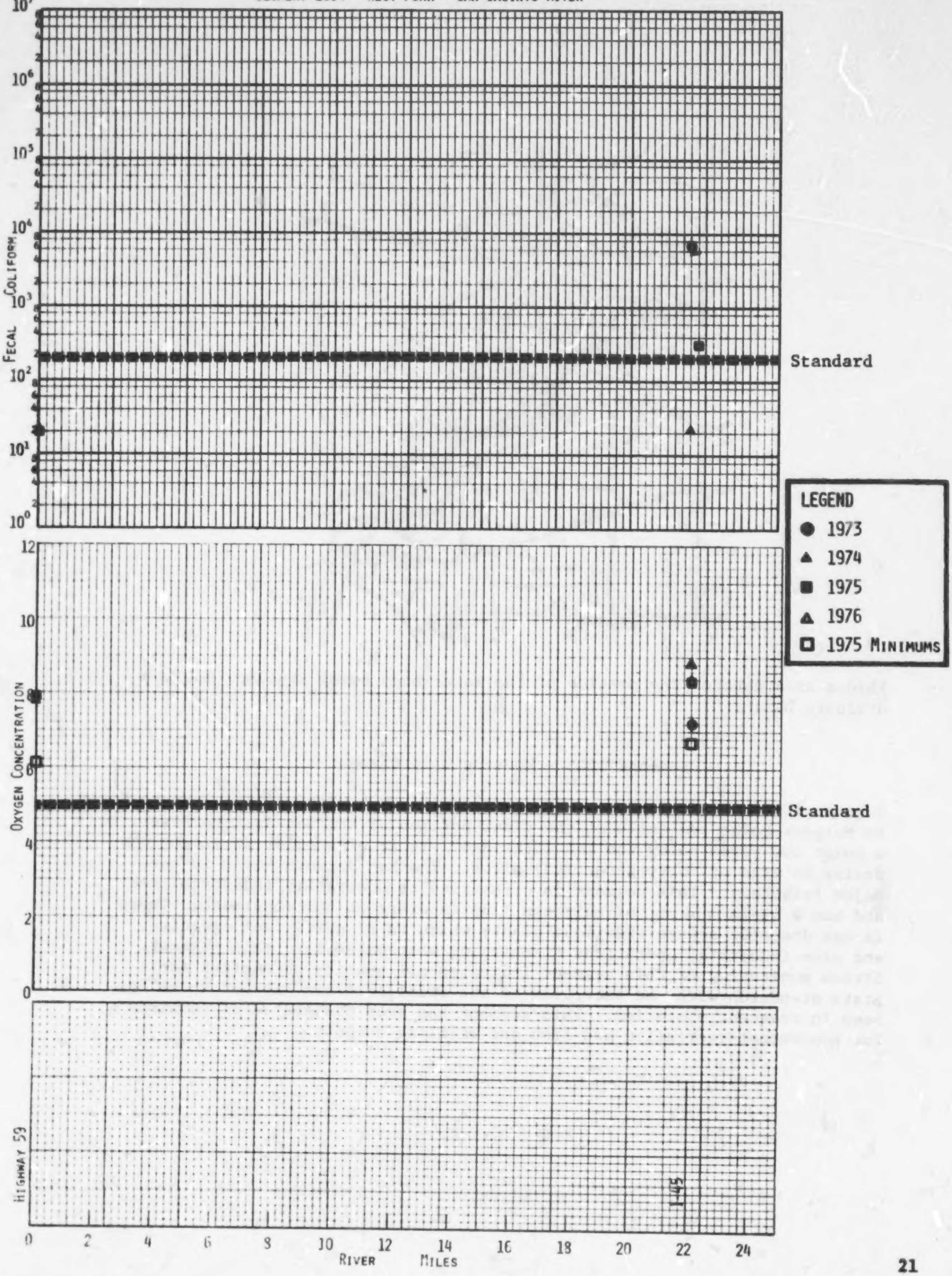

MONTGOMERY CO.
WALLER CO.
HARRIS CO.
LIB
NATIONAL FOREST
CUT AND SHOOT
NORTH CLEVELAND
CLEVELAND
CONROE
SPLENDORA
PATTON VILLAGE
PLUM GROVE
MAGNOLIA
TOMBALL
HUMBLE
PRAIRIE VIEW
JERSEY VILLAGE

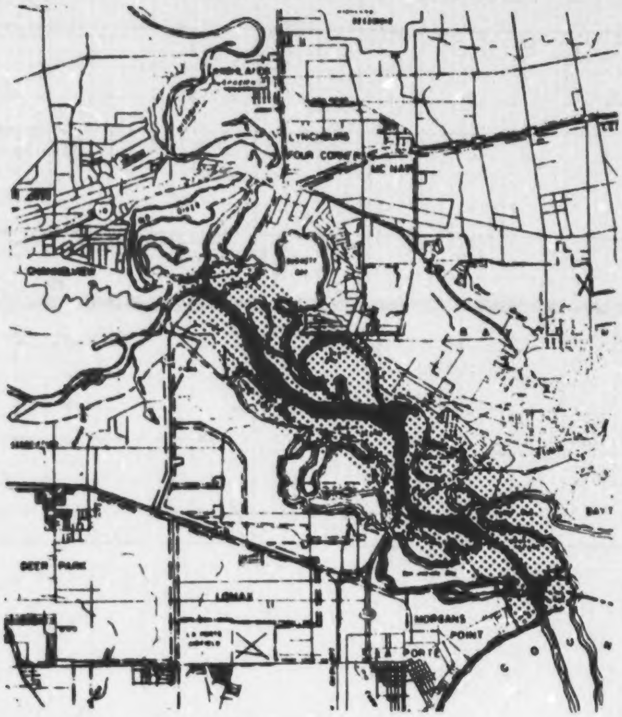
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1004 - West San Jacinto River

Segment 1004 is approximately thirty-seven (37) miles in length, running from Lake Houston to the Lake Conroe Dam and has a drainage area of 537 miles. Its tributaries include Crystal, Little Caney, and Stewarts Creeks, the East and West Forks of White Oak Creek, and Lake Creek. It is predominately rural except for the City of Conroe (population 12,000 - 1970). Discharging into this segment are eleven (11) domestic sewage treatment plants, two industrial operations and no agricultural activities. The yearly averages of three of the domestic major treatment plans exceeded standards during the years of 1972 - 1974. The basin ranking is twenty-second in order of noncompliance with quality standards. This segment has been designated as suitable for contact recreation, noncontact recreation, supportive of fish and wildlife, and a raw water supply.

SEGMENT 1004 - WEST FORK - SAN JACINTO RIVER



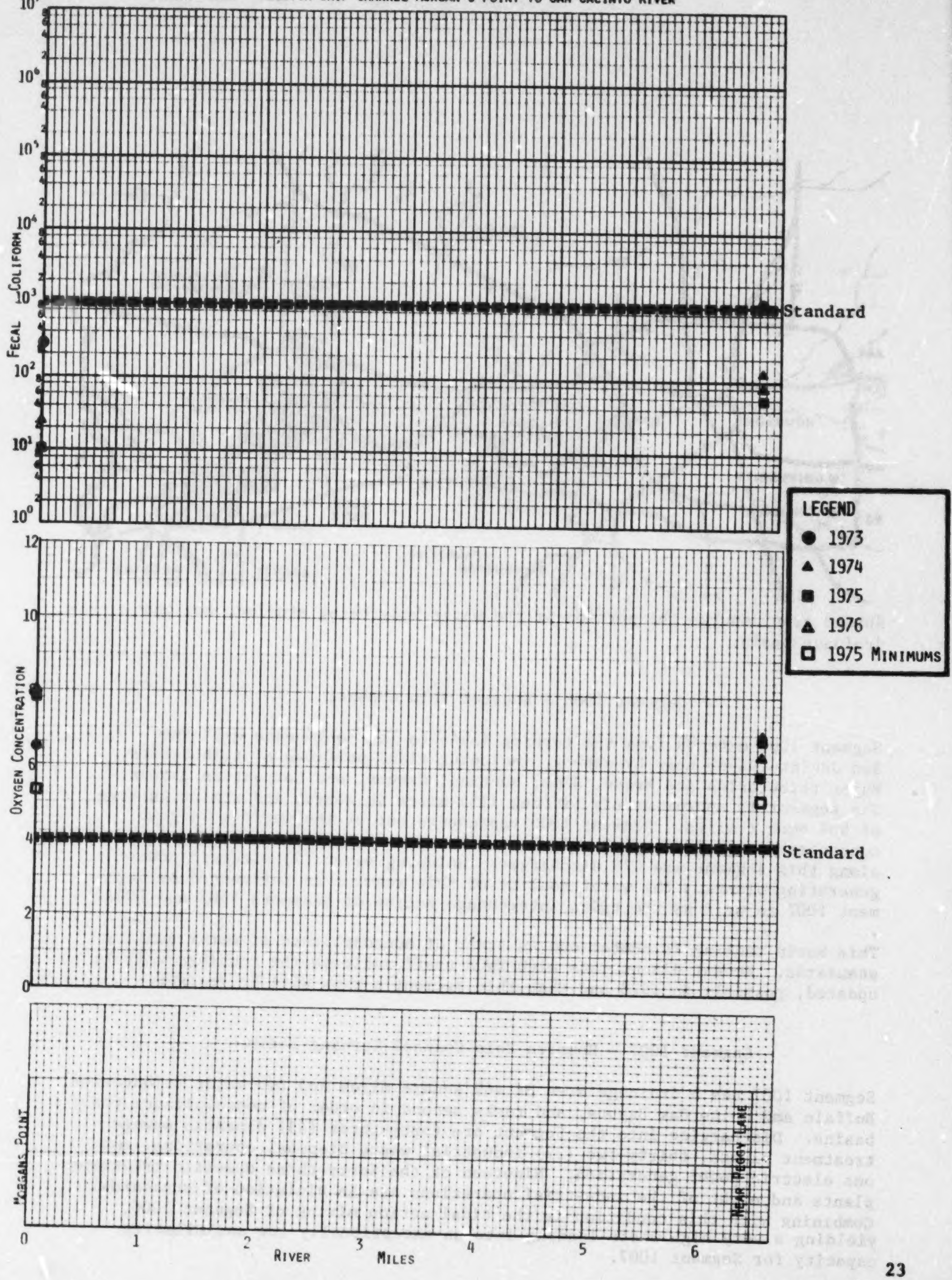


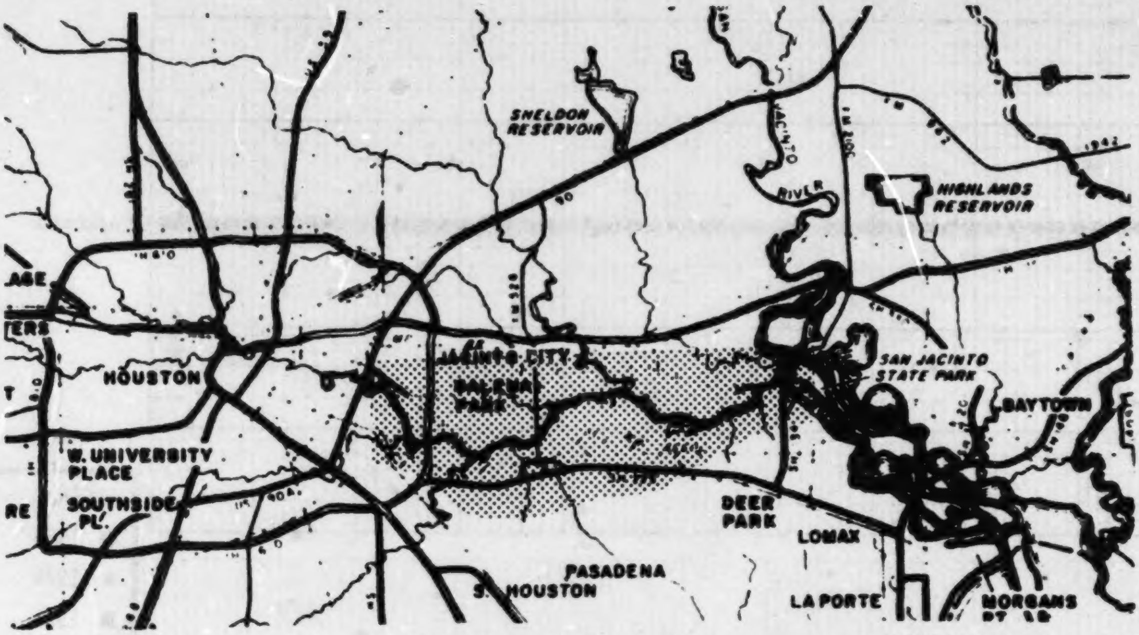
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1005 - Houston Ship Channel

Segment 1005 extends downstream from its confluence with the San Jacinto River to Morgans Point and includes the tidal portion of the San Jacinto River, to a point 200 yards below the I-H 10 bridge. It is nine miles in length and drains an area of forty-three (43) miles. The San Jacinto River is the major tributary. This segment is classified as moderately industrialized and has a basin ranking of thirteen (13) in order of noncompliance. There is one domestic sewage treatment plant, which is of sufficient capacity, and nine industrial operations discharging wastewater into this segment. Stream monitoring of this segment indicates all quality parameters meet state standards with the exception of the fecal coliform content which has been in frequent violation. This segment has been designated as suitable for noncontact recreation and fish and wildlife support.

SEGMENT 1005 - HOUSTON SHIP CHANNEL MORGAN'S POINT TO SAN JACINTO RIVER




SHELDON RESERVOIR
HIGHLANDS RESERVOIR
JACINTO
RIVER
HOUSTON
JACINTO CITY
GALENA PARK
SAN JACINTO STATE PARK
BAYTOWN
W. UNIVERSITY PLACE
SOUTHSIDE PL.
DEER PARK
LOMAX
PASADENA
S. HOUSTON
LA PORTE
MORGANS PT

Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1006 - Houston Ship Channel

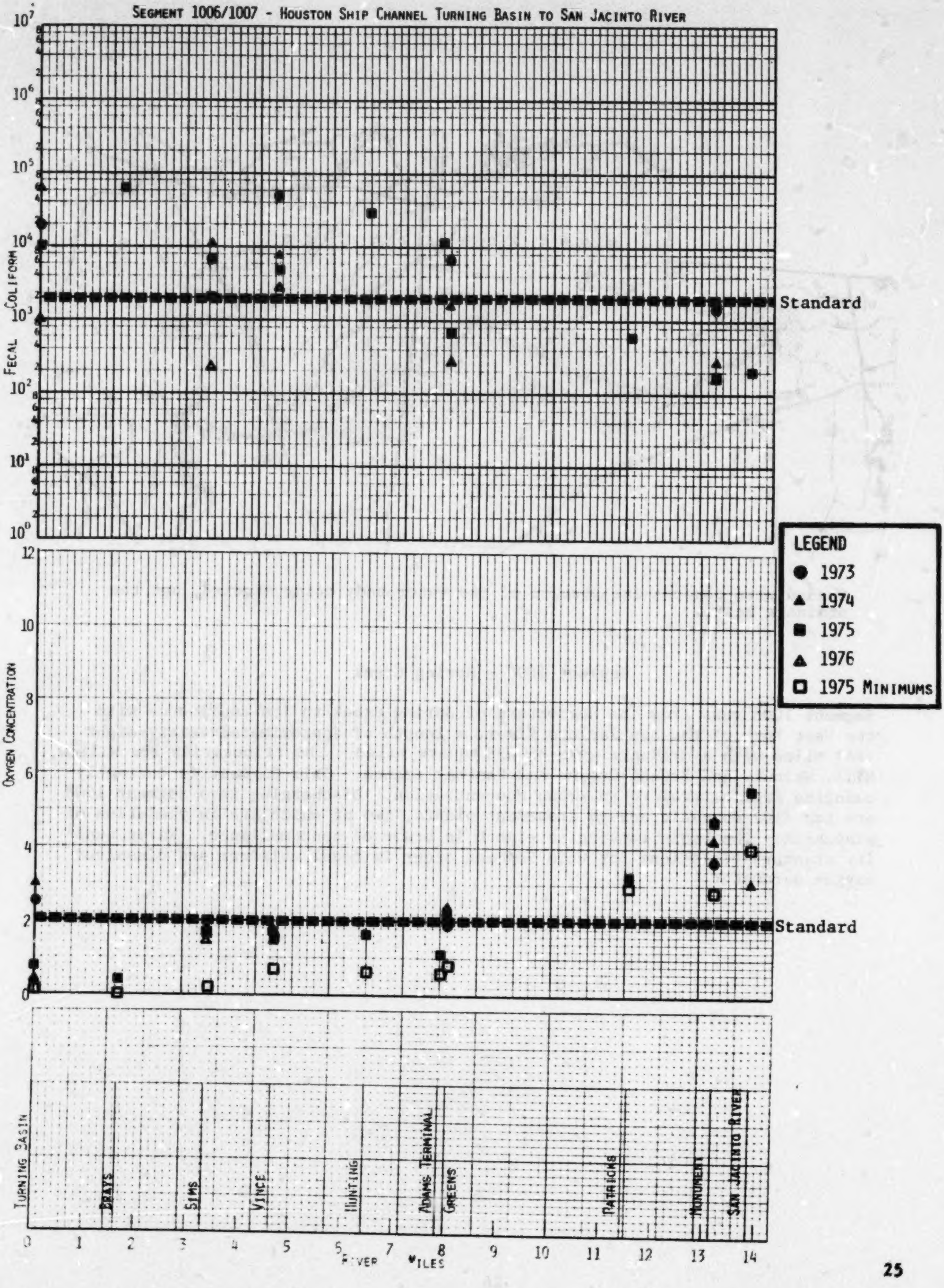
Segment 1006 extends from the turning basin to its confluence with the San Jacinto River near Lynchburg, including tidal portions of tributaries. Major tributaries are Brays, Sims, Hunting, Greens, and Carpenters Bayous. The segment is approximately fifteen (15) miles in length and drains an area of 584 square miles. Segment 1006 represents one of the world's largest concentration of industrial and municipal wastewater effluent dischargers; along this segment are 279 dischargers including seven (7) electric power generating plants. The water quality of this segment is influenced by Segment 1007 as well as the tidal interchange action of Segments 1005 and 1001.

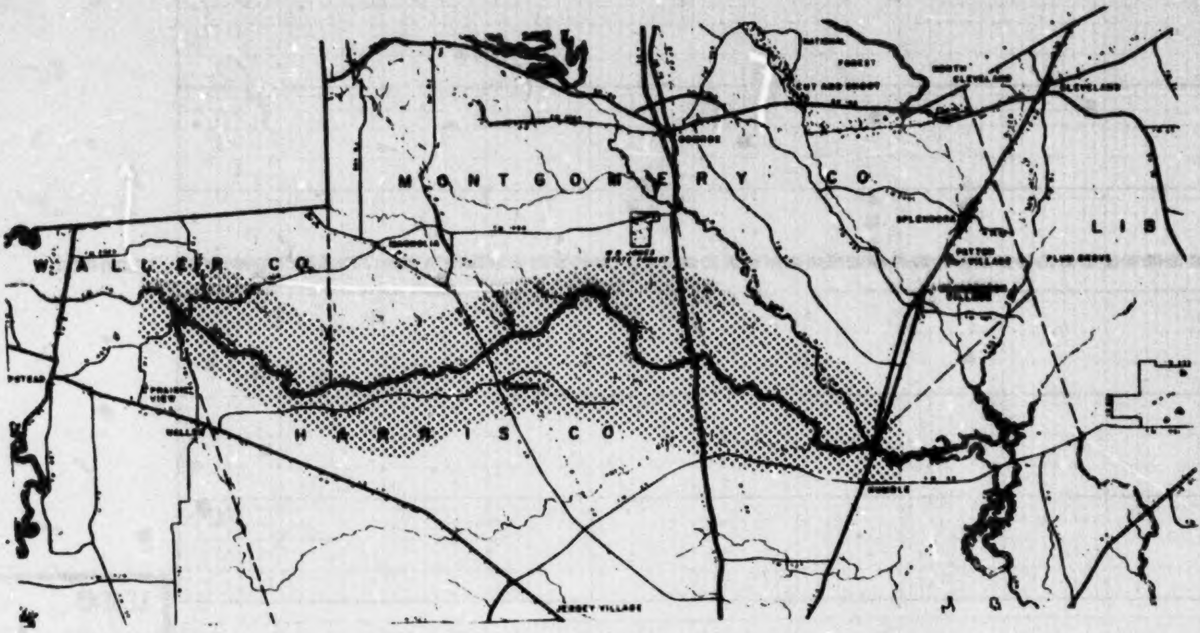
This basin ranking is number one in order of noncompliance of water quality standards. Recent discussions with TWQB staff indicate the rankings will be updated, possibly in 1978 and that this segment's rank will be changed.

Segment 1007 - Houston Ship Channel Turning Basin

Segment 1007 has a drainage area of 469 square miles and two major tributaries, Buffalo and White Oak Bayous, and ranks second in order of noncompliance for basins. Discharging into the Segment are forty-three (43) domestic sewage treatment plants, thirty-two (32) industrial waste disposal operations, and one electric power generation. Nineteen of the forty-three domestic treatment plants and eight of the industrial operations are in violation of standards. Combining with this condition is the tidal action mixing of Segment 1006, yielding a very high waste loading into an exceptionally low assimilative capacity for Segment 1007.

SEGMENT 1006/1007 - HOUSTON SHIP CHANNEL TURNING BASIN TO SAN JACINTO RIVER



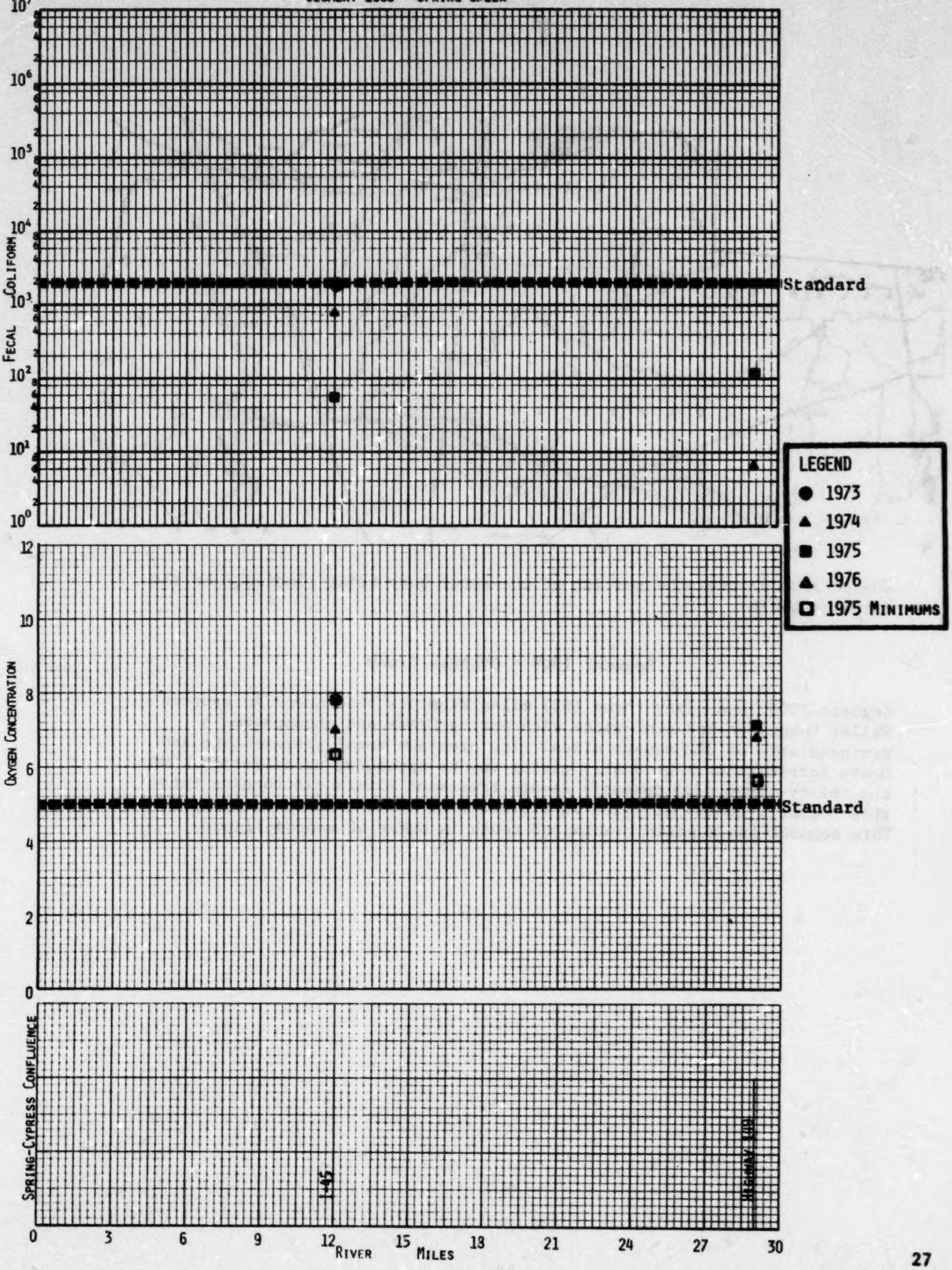

MONTGOMERY CO.
WALLER CO.
HARRIS CO.
LIB
NATIONAL
FOREST
CUT AND SHOOT
NORTH CLEVELAND
CLEVELAND
CONROE
MAGNOLIA
SPLENDORA
PATTON VILLAGE
PLUM GROVE
PRAIRIE VIEW
WALLER
HUMBLE
JERSEY VILLAGE

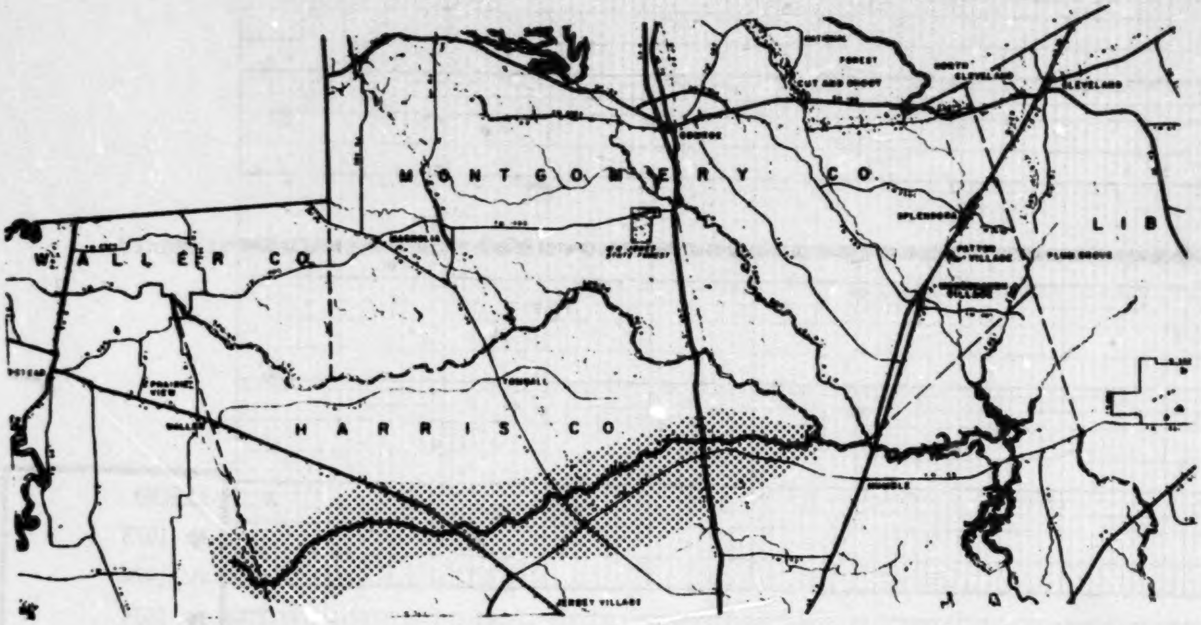
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1008 - Spring Creek

Segment 1008 runs from the headwaters of Spring Creek to its confluence with the West Fork of the San Jacinto River, a length of approximately sixty-eight (68) miles with a drainage area of 438 square miles. The tributaries are Willow, Mill, Walnut, and Brushy Creeks and Panther Branch. This Segment is currently changing from a rural to an urban concentration. Discharging into Segment 1008 are ten (10) domestic sewage treatment plants, two of which are in violation of standards. The basin ranking is eighth in order of noncompliance. Water quality standard violations for this Segment occur in fecal coliform and dissolved oxygen parameter.

SEGMENT 1008 - SPRING CREEK

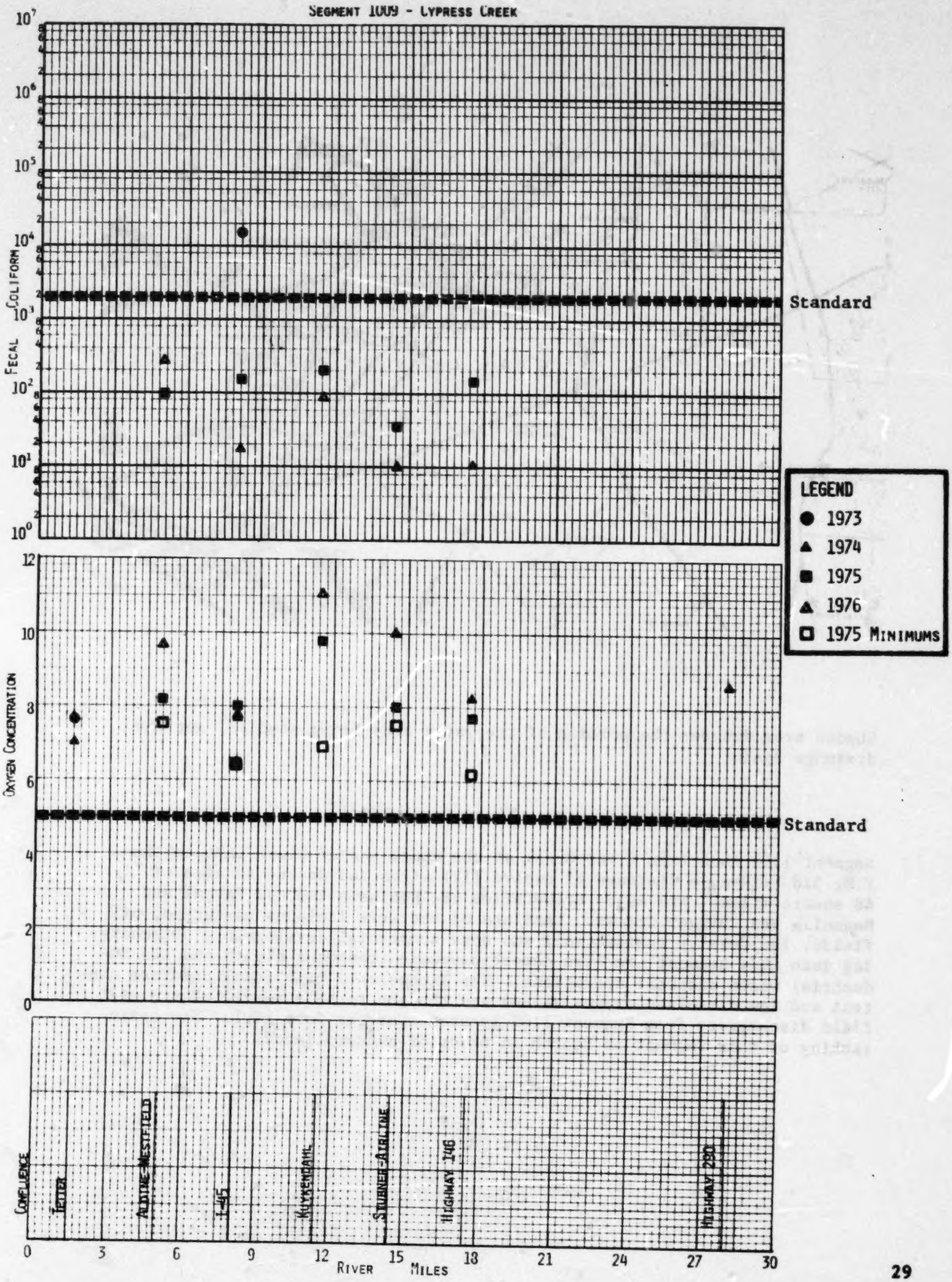


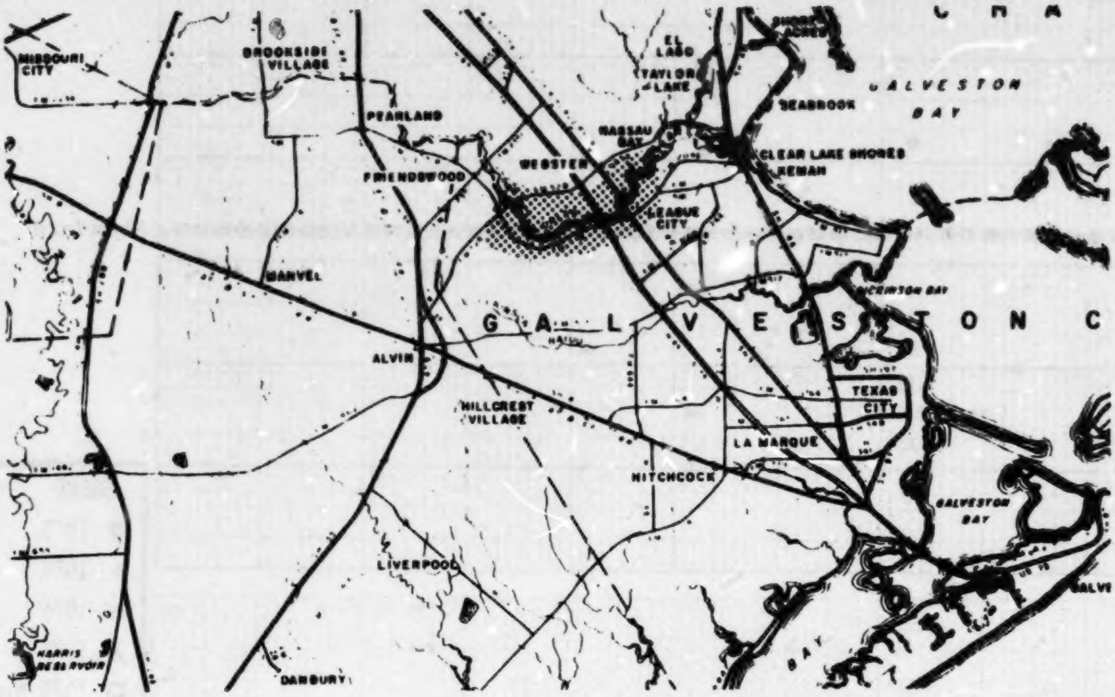

M O N T G O M E R Y   C O.
W A L L E R   C O.
H A R R I S   C O
L I B
CLEVELAND
TOMBALL
JERSEY VILLAGE

Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1009 - Cypress Creek

Segment 1009 runs sixty-three (63) miles from its headwaters in eastern Waller County to its confluence with Spring Creek and encompasses a drainage area of 322 square miles. Its previous rural predominance and heavy forestation is gradually giving way to spreading urbanization. Of the thirty-three (33) domestic sewage treatment plants discharging into this Segment, twenty (20) are in violation of water quality standards. This segment has a basin ranking of tenth in order of noncompliance.


SEGMENT 1009 - CYPRESS CREEK

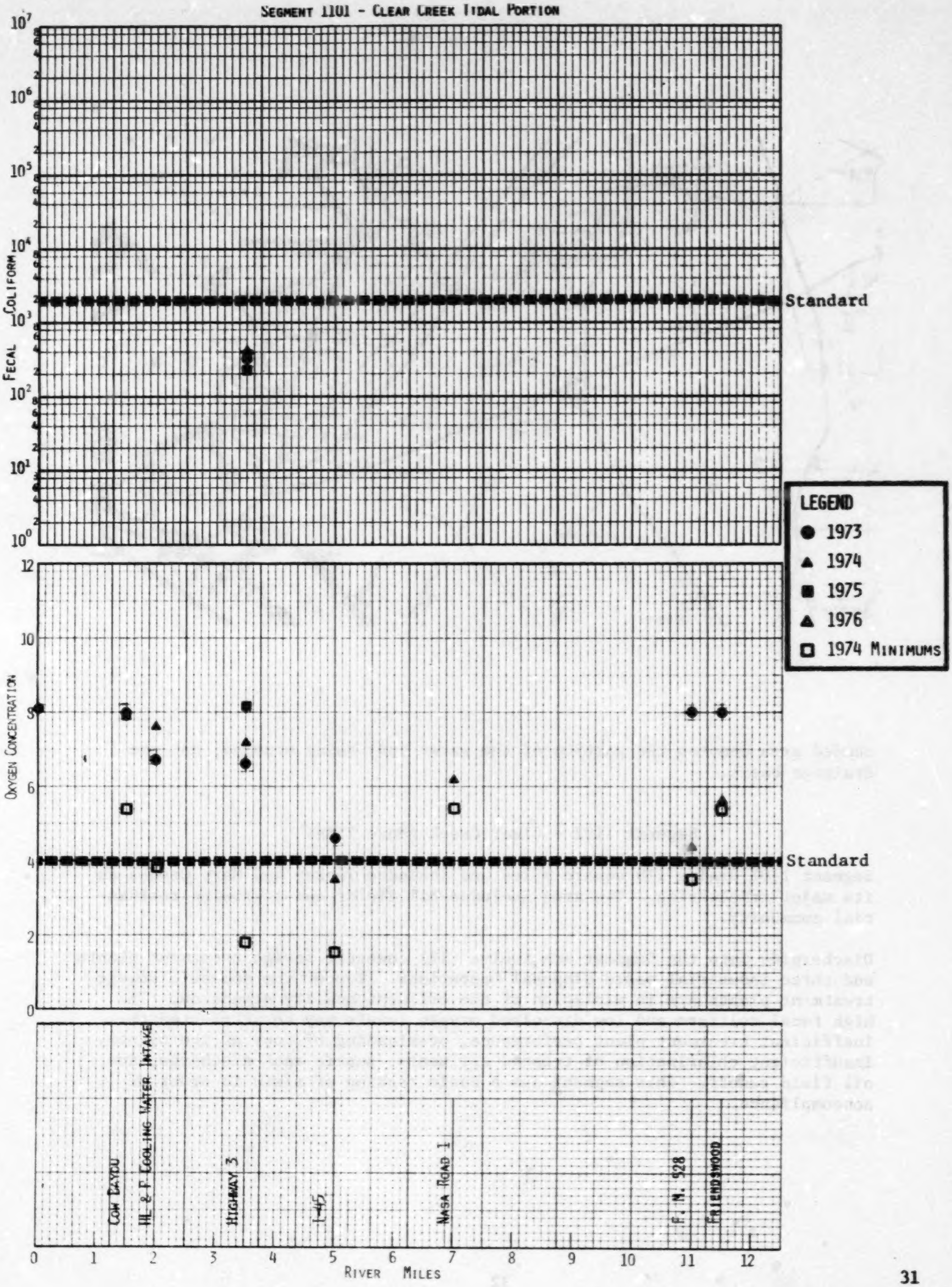

MISSOURI CITY
BROOKSIDE VILLAGE
PEARLAND
FRIENDSWOOD
MANVEL
WEBSTER
NASSAU BAY
EL LAGO
TAYLOR LAKE
SHORE ACRES
SEABROOK
GALVESTON BAY
CLEAR LAKE SHORES
KEMAH
LEAGUE CITY
DICKINSON BAY
G A L V E S T O N C
ALVIN
HILLCREST VILLAGE
TEXAS CITY
LA MARQUE
HITCHCOCK
GALVESTON BAY
LIVERPOOL
DANBURY
HARRIS RESERVOIR
BAY
GALVE

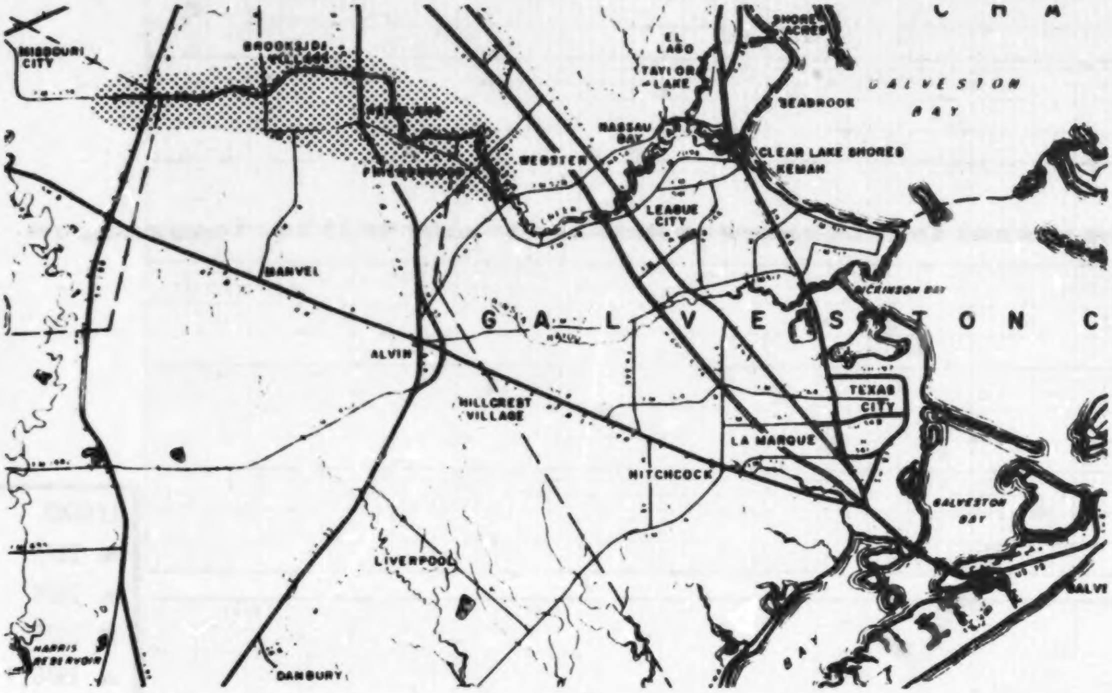
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1101 - Clear Creek Tidal

Segment 1101 runs from Clear Creek at the upper end of Clear Lake to the F.M. 528 bridge, a distance of twelve (12) miles and drains an area of 48 square miles. Its major tributaries are Robinson and Cow Bayous and Magnolia and Chigger Creeks. Land use of the area includes pasturage, oil fields, low density residential, and some commercial development. Discharging into this segment are five domestic sewage treatment plants and two industrial waste disposal operations. The excessively high fecal coliform content and low dissolved oxygen values are thought to be a result of the oil field dischargers from Segment 1102 located upstream from 1101. The basin ranking of this Segment is fourth in order of noncompliance.

SEGMENT 1101 - CLEAR CREEK TIDAL PORTION




MISSOURI CITY
BROOKSIDE VILLAGE
PEARLAND
FRIENDSWOOD
WEBSTER
NASSAU BAY
TAYLOR LAKE
EL LAGO
SHORE ACRES
SEABROOK
GALVESTON BAY
CLEAR LAKE SHORES
KEMAH
LEAGUE CITY
MANVEL
DICKINSON BAY
G A L V E S T O N C
ALVIN
HILLCREST VILLAGE
TEXAS CITY
LA MARQUE
HITCHCOCK
GALVESTON BAY
LIVERPOOL
HARRIS RESERVOIR
DANBURY
BAY

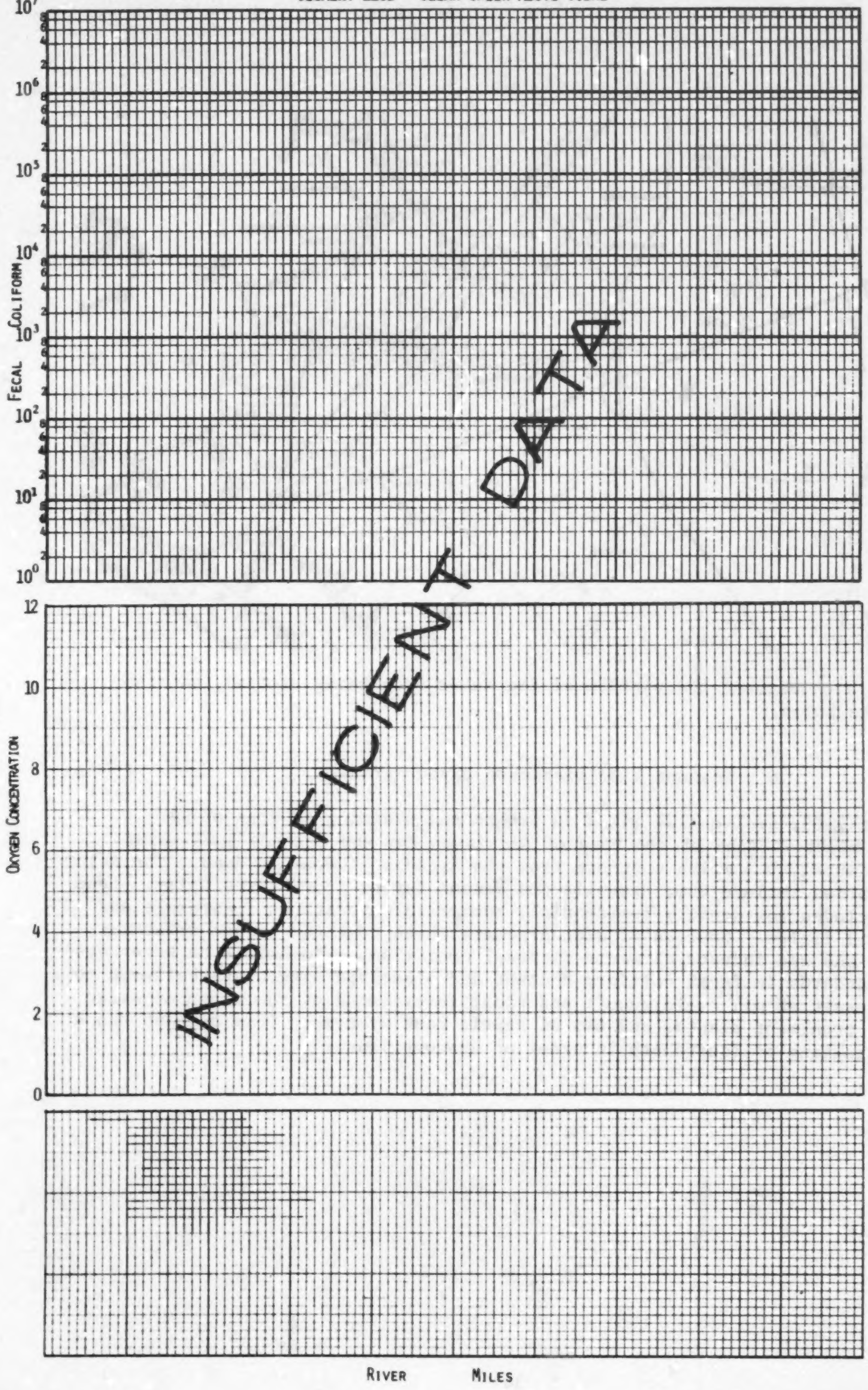
Shaded area denotes the portion of the water body being studied, not the drainage basin.

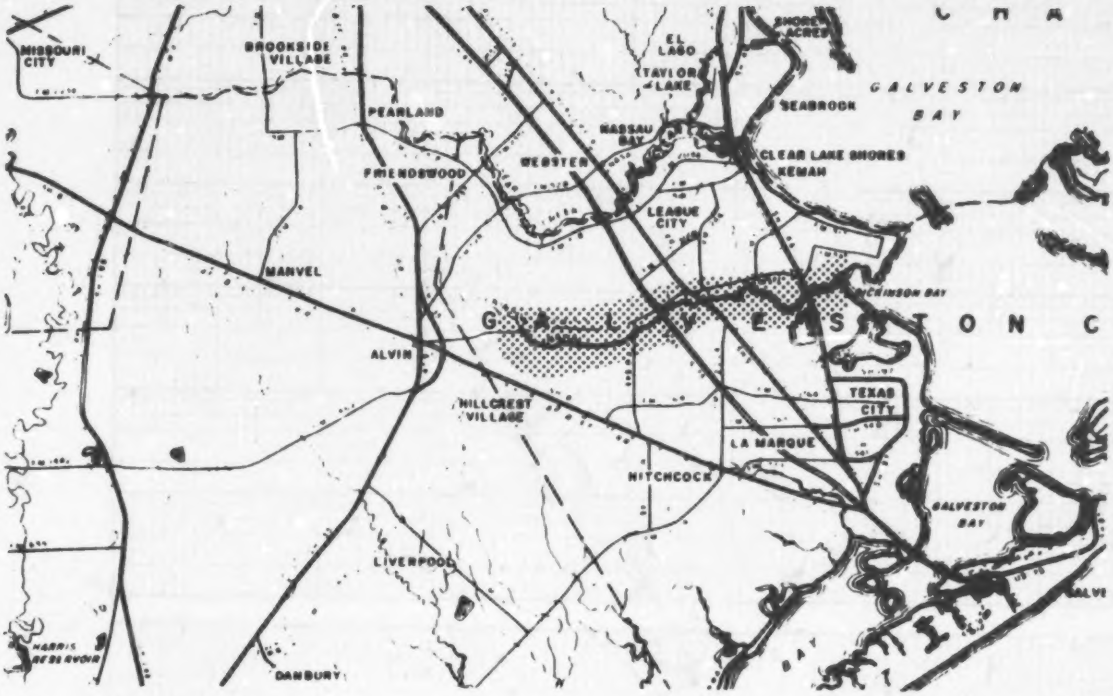
Segment 1102 - Clear Creek Above Tidal

Segment 1102 drains 118 square miles and includes Turkey and Mary Creeks as its major tributaries. The area includes oil fields and a growing residential community.

Discharging into the Segment are twelve (12) domestic sewage treatment plants and three industrial waste disposal operations. Two of the domestic sewage treatment plants are in violation of the effluent quality standards. The high fecal coliform and low dissolved oxygen levels may be attributed to: inefficient treatment plant performance, overloading of four of the plants, insufficient chlorination of treated effluents, septic tank discharge, and oil field runoff. This segment has a basin ranking of sixth in order of noncompliance.

SEGMENT 1102 - CLEAR CREEK ABOVE TIDAL



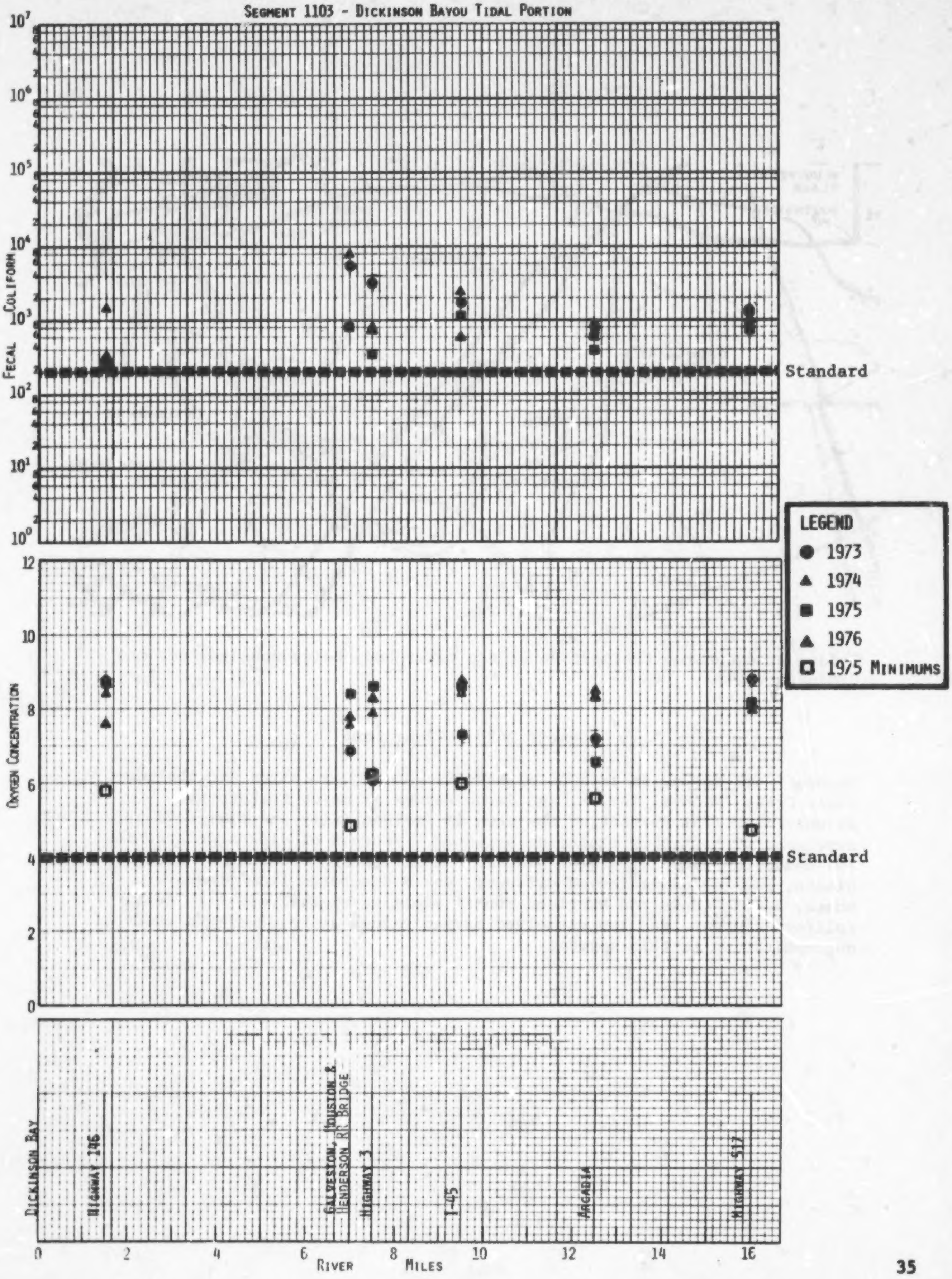

MISSOURI CITY
BROOKSIDE VILLAGE
PEARLAND
FRIENDSWOOD
WEBSTER
NASSAU BAY
EL LAGO
TAYLOR LAKE
SHORE ACRES
SEABROOK
GALVESTON BAY
CLEAR LAKE SHORES
KEMAH
LEAGUE CITY
DICKINSON BAY
MANVEL
ALVIN
GALVESTON C
HILLCREST VILLAGE
TEXAS CITY
LA MARQUE
HITCHCOCK
GALVESTON BAY
LIVERPOOL
HARRIS RESERVOIR
DANBURY
BAY

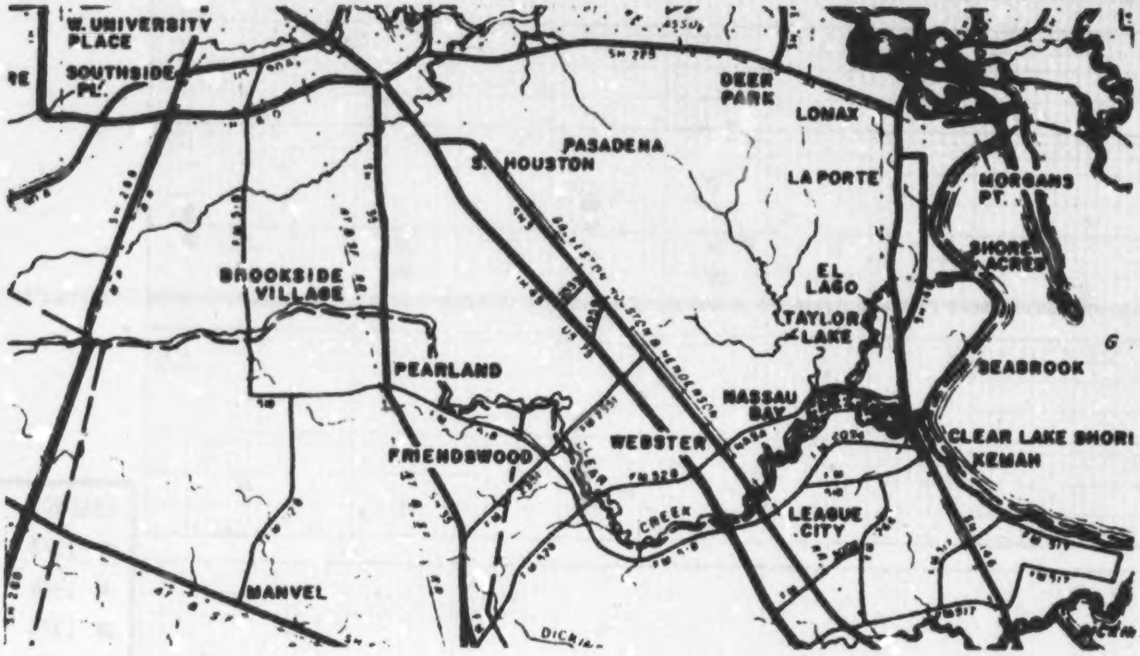
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 1103 Dickinson Bayou - Tidal

Segment 1103, twelve (12) miles in length and draining an area of 59 square miles, begins at the head of Dickinson Bay and extends to a point approximately 0.4 miles upstream from the Arcadia - Cemetery Road. The major tributaries include Gum, Magnolia and Benson Bayous and Bordens Gully. Land use includes low density residential, commercial operations, pasturage and some oil fields. Sources of discharge are three domestic sewage treatment plants and one industrial waste disposal operation. Violations of water quality standards in fecal coliform content and dissolved oxygen are believed to be a result of oil field runoff and tidal interchange of the three domestic sewage treatment plants, and use of septic tank systems. This segment has a basin ranking of fourteenth in order of noncompliance.

SEGMENT 1103 - DICKINSON BAYOU TIDAL PORTION



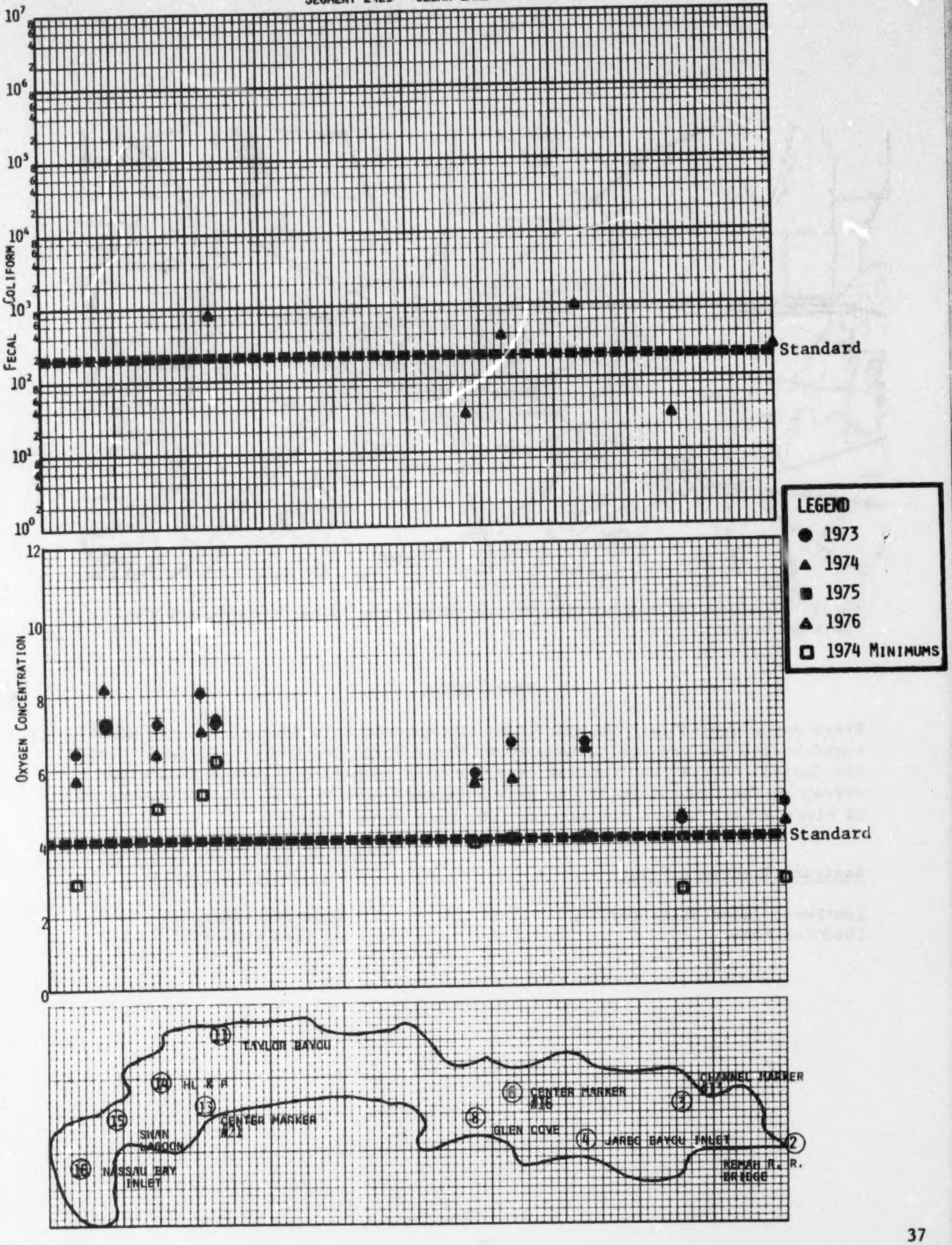

W. UNIVERSITY PLACE
SOUTHSIDE PL.
DEER PARK
LOMAX
PASADENA
S. HOUSTON
LA PORTE
MORGANS PT.
SHORE ACRES
BROOKSIDE VILLAGE
EL LAGO
TAYLOR LAKE
6
SEABROOK
PEARLAND
NASSAU BAY
WEBSTER
CLEAR LAKE SHORI
KEMAH
FRIENDSWOOD
CLEAR CREEK
LEAGUE CITY
MANVEL

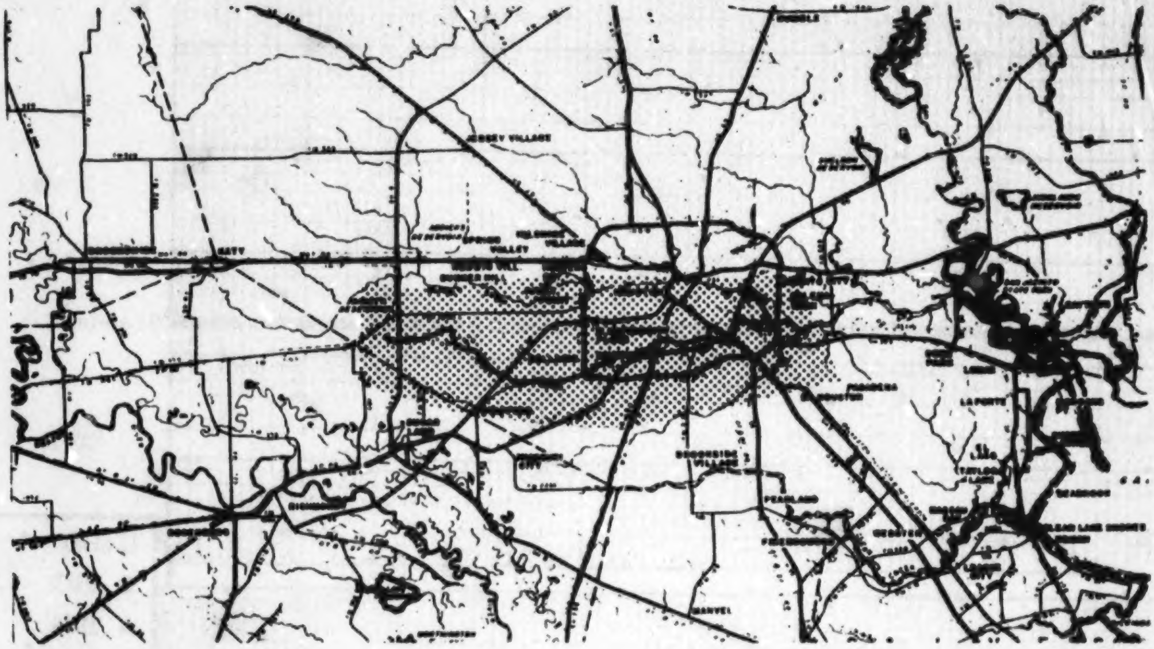
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Segment 2425 - Clear Lake

Segment 2425 drains an area of eighty-six (86) square miles and includes Clear Creek, Middle, Taylor, and Jarbo Bayous as major tributaries. Seventy-five (75) percent of the area is residentially and commercially developed with further expansion expected. Sources of discharge are nine (9) domestic sewage treatment plants. Insufficient treatment by sewage plants, poor chlorination of effluent, waste discharge from pleasure boats, septic tanks and overland runoff yielding excessively high fecal coliform content, and low dissolved oxygen values are producing a state of eutrophication in this segment.

SEGMENT 2425 - CLEAR LAKE





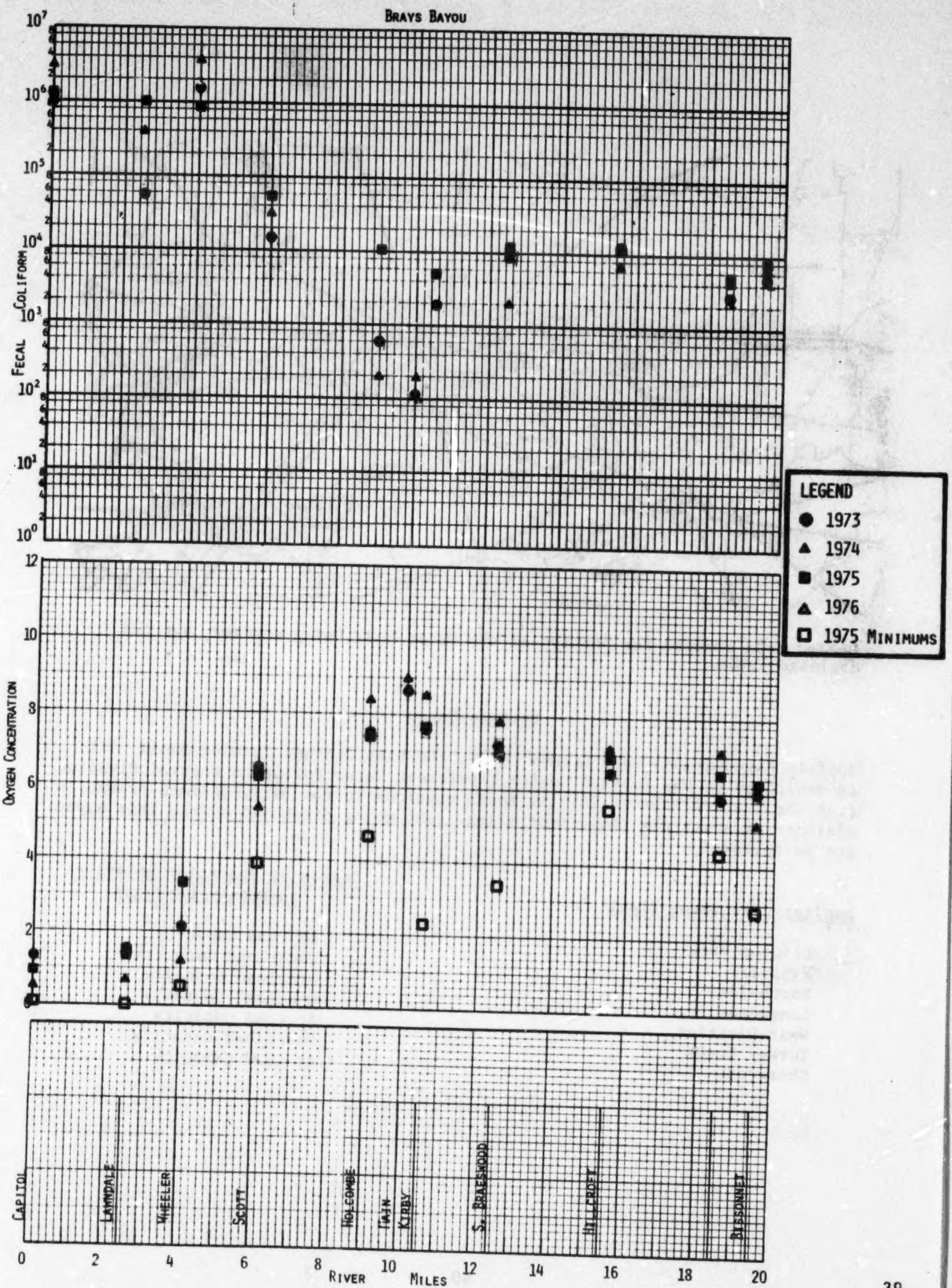
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Brays Bayou

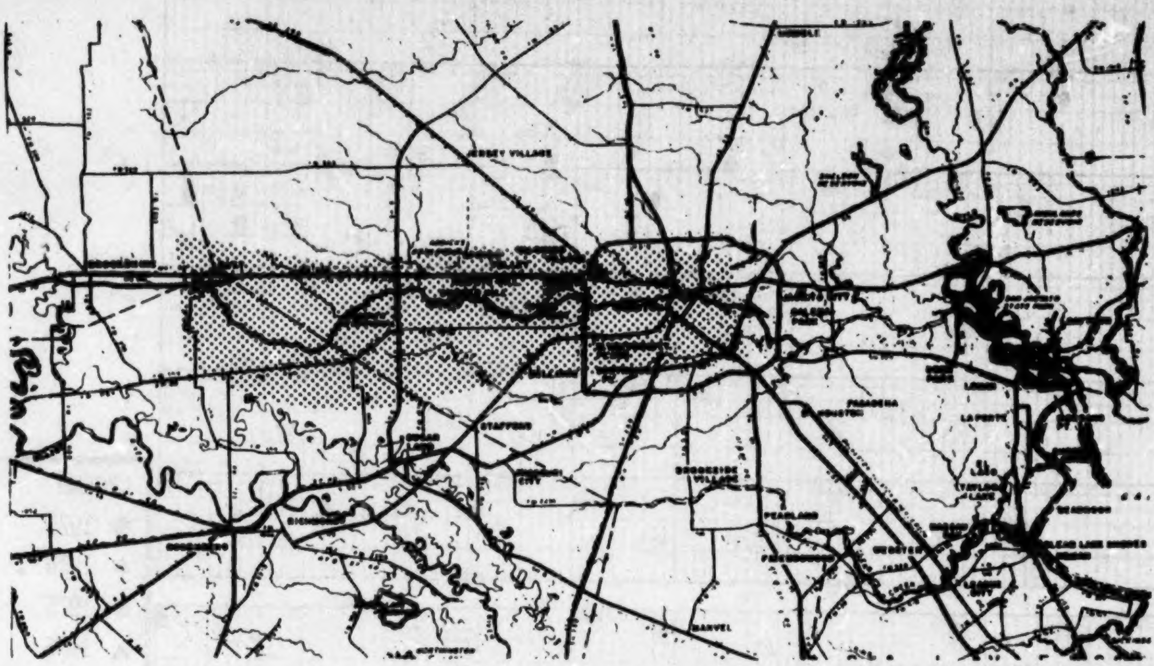
Brays Bayou drains into Segment 1006, the Houston Ship Channel. It is monitored by the Houston Health Department Water Pollution Control Division from the Capitol Avenue boat landing near its ship channel confluence thence upstream to the Club Creek Bridge near Bissonnet west of U.S. 59, a distance of 33 river miles. Major dischargers into this bayou include:

Sanitary Treatment Plant	Status of Operation Relative to Design Capacity
Southwest (near Bellaire)	Underload Capacity
Chadwick Manor	At Load Capacity

BRAYS BAYOU



10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
FECAL COLIFORM
12
10
8
6
4
2
0
OXYGEN CONCENTRATION
LEGEND
● 1973
▲ 1974
■ 1975
▲ 1976
□ 1975 MINIMUMS
CAPITOL
LAWNDALE
WHEELER
SCOTT
HOLCOMBE
MAIN
KIRBY
S. BRAESWOOD
HILCROFT
BISSONNET
0
2
4
6
8
10
12
14
16
18
20
RIVER MILES

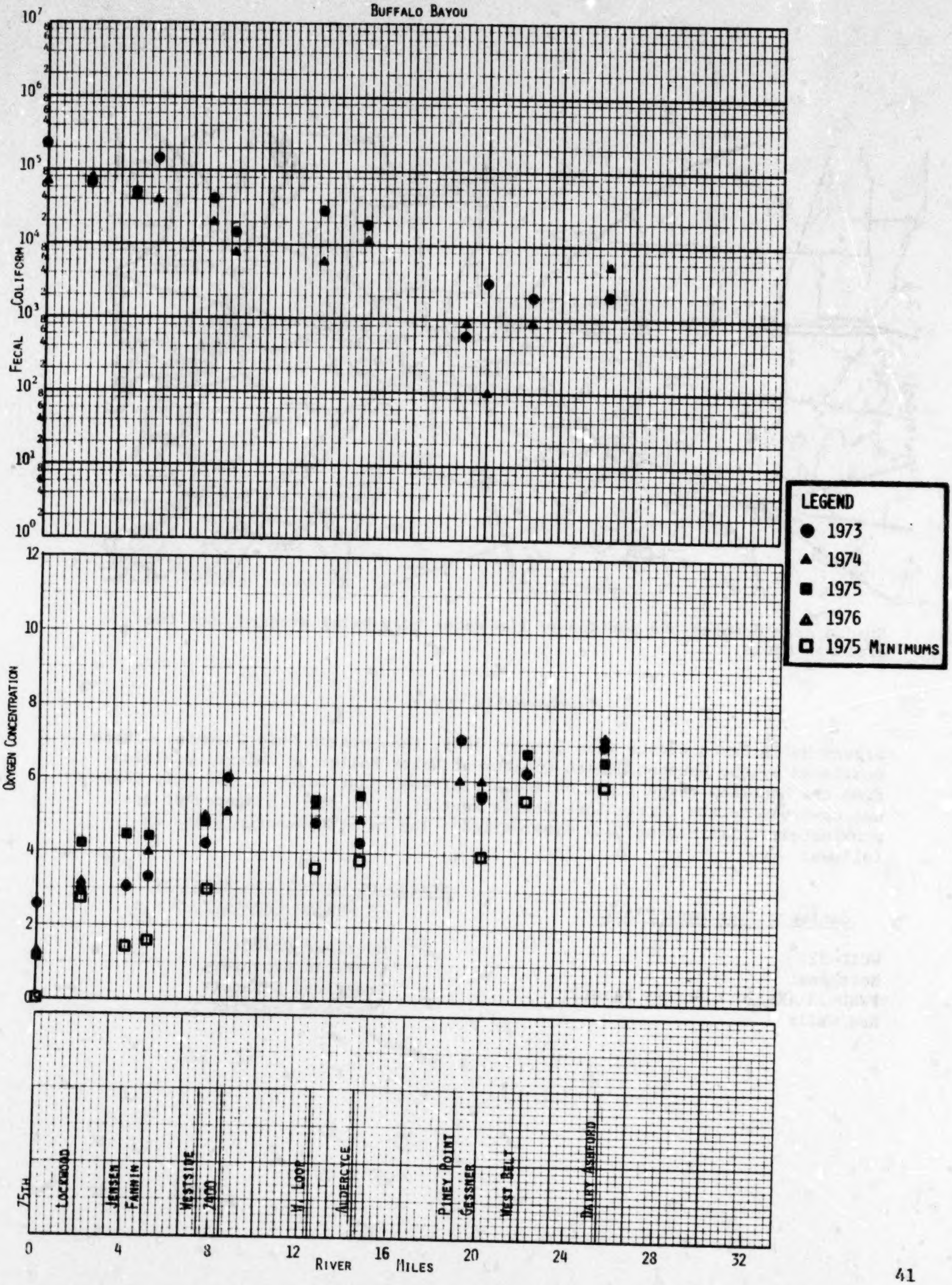


Shaded area denotes the portion of the water body being studied, not the drainage basin.

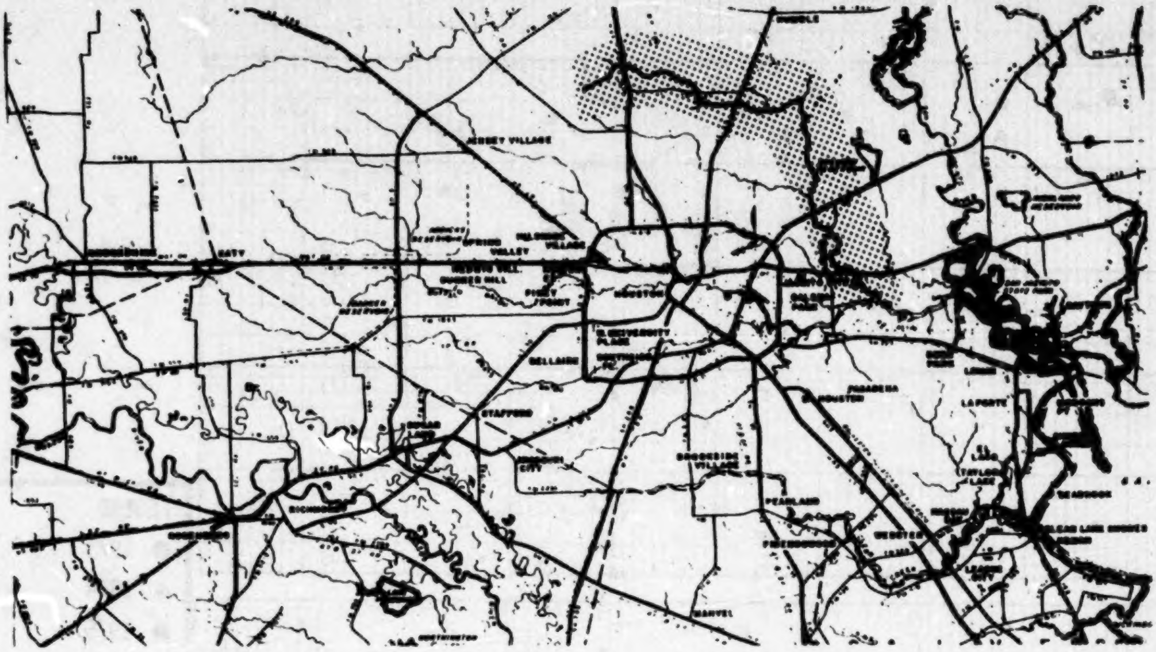
Buffalo Bayou

Buffalo Bayou drains into Segment 1007, the Ship Channel Turning Basin. It is monitored by the Houston Health Department Water Pollution Control Division from the Port of Houston Turning Basin upstream to the Dairy-Ashford Bridge, a distance of sixty-six (66) river miles. The major dischargers into this bayou are as follows:

Sanitary Treatment Plant	Status of Operation Relative to Design Capacity
Clinton Park	At Load Capacity
FWSD 17	Underload Capacity
Northside	Overload Capacity
Longwoods	Overload Capacity
West District	At Load Capacity
Turkey Creek	Underload Capacity
Sherwood	At Load Capacity



BUFFALO BAYOU
FECAL COLIFORM
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
OXYGEN CONCENTRATION
0
2
4
6
8
10
12
LEGEND
● 1973
▲ 1974
■ 1975
▲ 1976
☐ 1975 MINIMUMS
75TH
LOCKWOOD
JENSEN
FANNIN
WESTSIDE
2400
W. LOOP
AUDERCYCE
PINEY POINT
GESSNER
WEST BELT
DAIRY ASHFORD
0
4
8
12
16
20
24
28
32
RIVER MILES



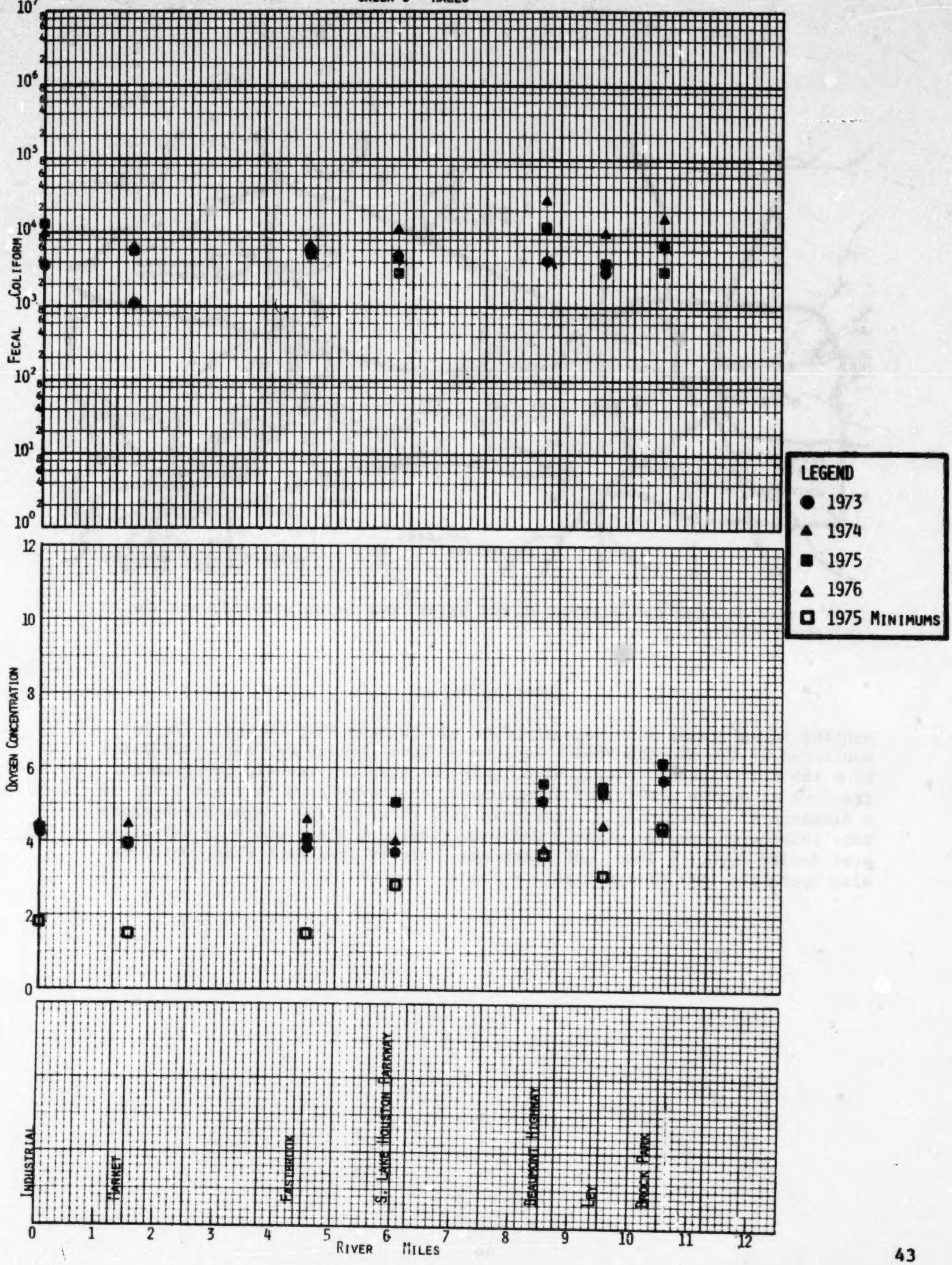
Shaded area denotes the portion of the water body being studied, not the drainage basin.

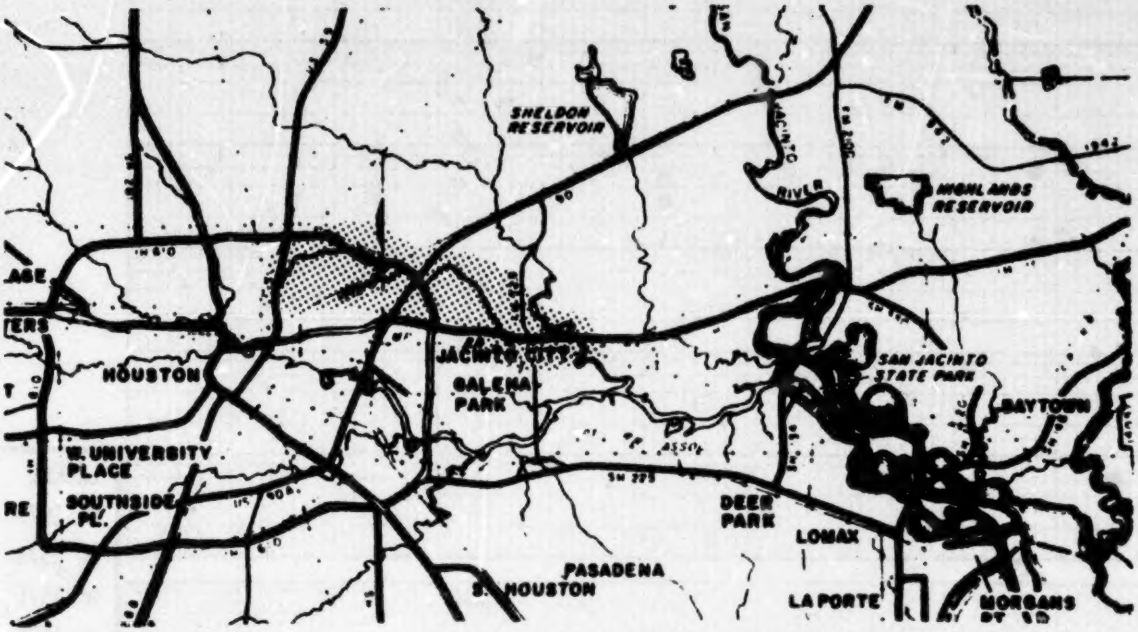
Greens-Halls Bayou

Greens-Halls Bayou drains into Segment 1006, the Houston Ship Channel. It is monitored by the Houston Health Department Water Pollution Control Division from the Mechling Barge Lines on Industrial Road just North of the Ship Channel upstream to the Little York Bridge west of U. S. 59, a distance of approximately thirty-three (33) river miles. The major dischargers are as follows:

Sanitary Treatment Plant	Status of Operations Relative to Design Capacity
WCID-32	Overload Capacity
Northeast	Overload Capacity
FWSD-23 (Kellett Street Plant)	Underload Capacity
Red Gully	Overload Capacity

GREEN'S - HALLS

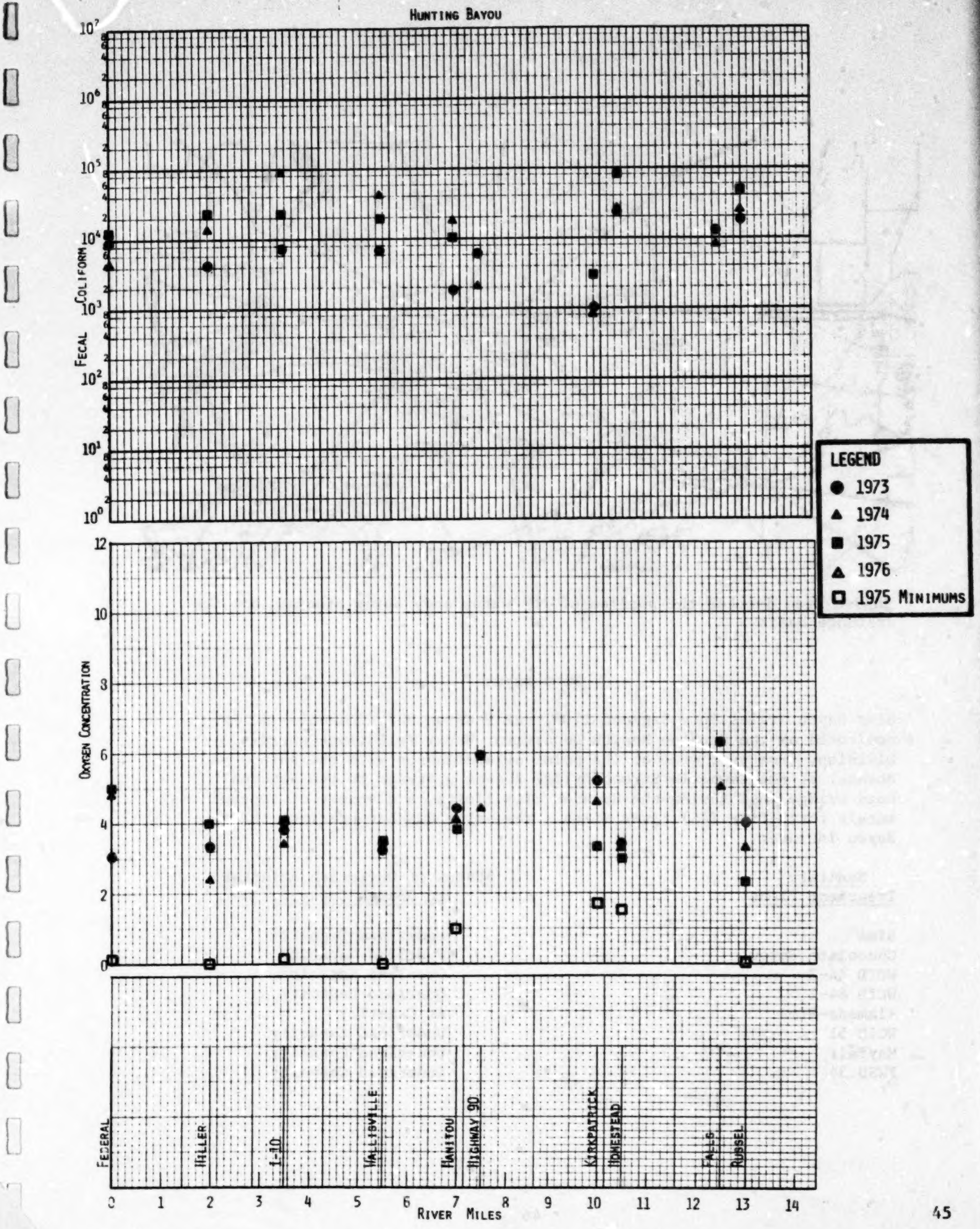


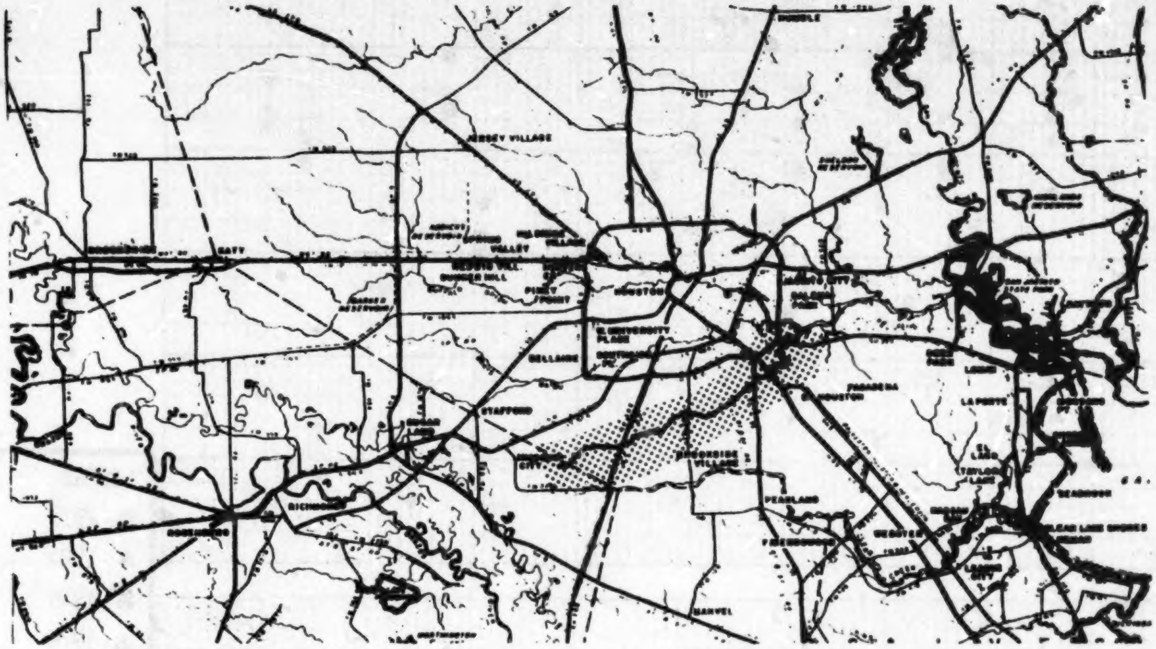

SHELDON RESERVOIR
HIGHLANDS RESERVOIR
RIVER
SAN JACINTO STATE PARK
BAYTOWN
HOUSTON
JACINTO CITY
GALENA PARK
W. UNIVERSITY PLACE
SOUTHSIDE PL.
DEER PARK
LOMAX
PASADENA
S. HOUSTON
LA PORTE
MORGANS PT.

Shaded area denotes the portion of the water body being studied, not the drainage basin.

Hunting Bayou

Hunting Bayou drains into Segment 1006, the Houston Ship Channel. It is monitored by the Houston Health Department Water Pollution Control Division from the northside of Federal Road, near the Washburn Tunnel, upstream to its fork at George and Russel Streets near the North Loop East and U. S. 59, a distance of approximately twenty-six (26) river miles. Major dischargers into this bayou include WCID-20 sanitary treatment plant which is operating over design capacity load, and Homestead Sanitary Treatment Plant which is also operating over design capacity load.


HUNTING BAYOU
FECAL COLIFORM
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
LEGEND
● 1973
▲ 1974
■ 1975
▲ 1976
☐ 1975 MINIMUMS
OXYGEN CONCENTRATION
0
2
4
6
8
10
12
FEDERAL
MILLER
I-10
WALLISVILLE
MANITOU
HIGHWAY 90
KIRKPATRICK
HOMESTEAD
FALL-G
RUSSEL
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
RIVER MILES

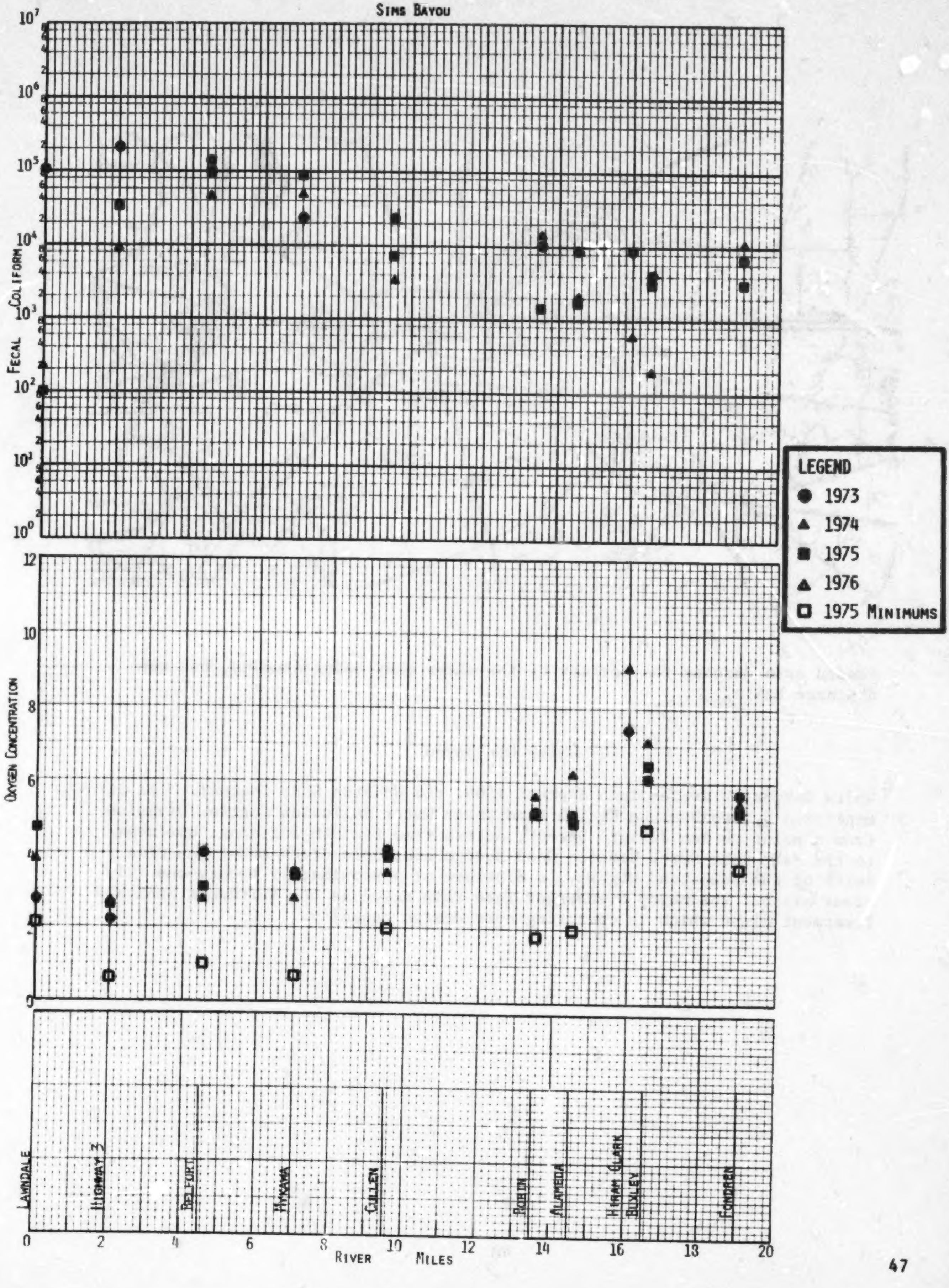


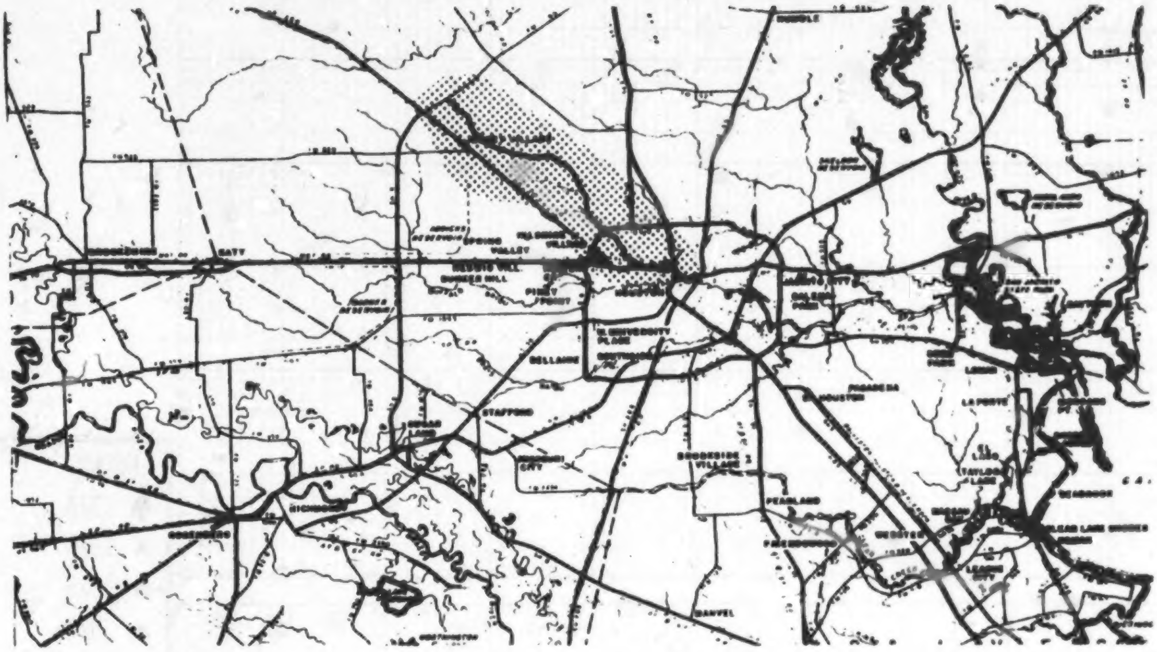
Shaded area denotes the portion of the water body being studied, not the drainage basin.

Sims Bayou

Sims Bayou drains into Segment 1006, the Houston Ship Channel. It is monitored by the Houston Health Department Water Pollution Control Division, from just west of its point of confluence with the ship channel at the Lawndale Street Bridge thence upstream to the Fondren Road bridge just inside the Houston city limits, a distance of approximately forty-five (45) river miles. The major dischargers into this Bayou include:

Sanitary Treatment Plant	Status of Operation Relative to Design Capacity
Sims	Underload Capacity
Chocolate Bayou	Overload Capacity
WCID 44-3	Overload Capacity
WCID 44-1	Overload Capacity
Alameda-Sims	At Capacity
WCID 51	Underload Capacity
Mayfair	Underload Capacity
FWSD 34	Underload Capacity

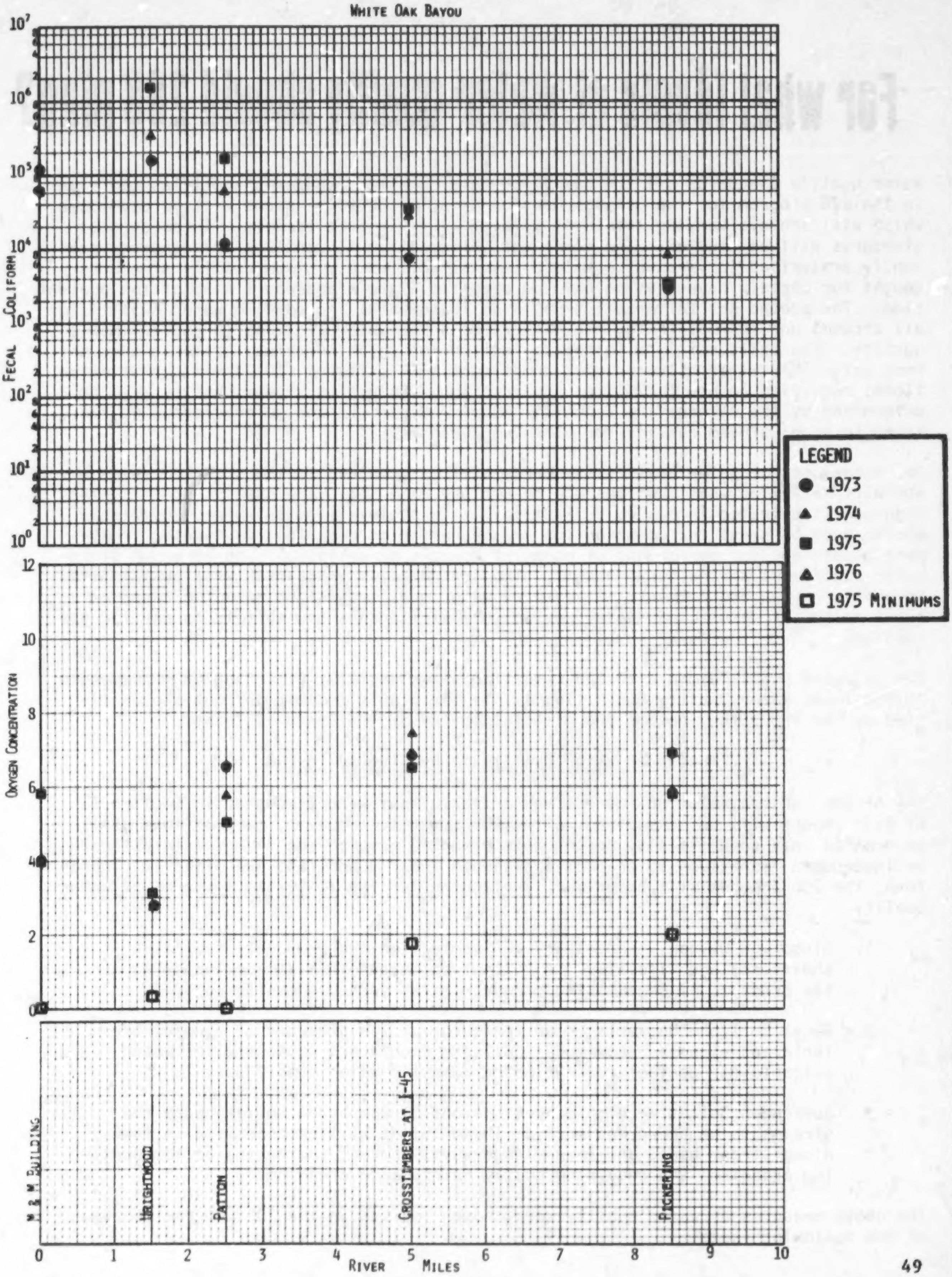

SIMS BAYOU
FECAL COLIFORM
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
OXYGEN CONCENTRATION
0
2
4
6
8
10
12
LEGEND
● 1973
▲ 1974
■ 1975
▲ 1976
□ 1975 MINIMUMS
LAWNDALE
HIGHWAY 3
BELFORT
HYKAWA
CULLEN
ROBIN
ALAMEDA
HIRAM CLARK
BUXLEY
FONDREN
0
2
4
6
8
10
12
14
16
18
20
RIVER MILES



Shaded area denotes the portion of the water body being studied, not the drainage basin.

White Oak Bayou

White Oak Bayou drains into Segment 1006, the Houston Ship Channel. It is monitored by the Houston Health Department Water Pollution Control Division from a point on San Jacinto Street, across from the M&M Building, upstream to the Fairbanks-North Houston Road Bridge over Cole Creek about one mile north of the Hempstead Highway, a distance of approximately twenty-one (21) river miles. The major discharger into this bayou is the Northwest Sanitary Treatment Plant which is operating over design capacity.


White Oak Bayou
Fecal Coliform
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
Oxygen Concentration
0
2
4
6
8
10
12
LEGEND
● 1973
▲ 1974
■ 1975
△ 1976
□ 1975 Minimums
M & M Building
Heightwood
Patton
Crosstimbers at I-45
Pickering
0
1
2
3
4
5
6
7
8
9
10
River Miles

For what levels of water quality should 208 plan?

Water quality standards set the basis for water quality management policies and plans. In the 208 program for the Greater Houston Area, alternative plans will be developed which will achieve varying levels of water quality in area streams. Three sets of standards will be studied. The first set (Alternative A) consists of standards presently prescribed for area streams and bays as well as a minimum quality standards sought for certain bayous which have no specific State standards listed at the present time. The second set (Alternative B) is an incremental increase in water quality for all streams and represents the minimum criteria for water of fishable and swimmable quality. The third set is a technology option for which numerical criteria have not been set. This alternative assumes compliance with existing (1977) effluent limitations, requiring no new facilities construction. Resulting stream quality will be determined by the Alternative Technical Subplan Contracts and be considered as the third level of stream quality for planning purposes.

The three sets of water quality standards will be provided to the technical planners who will determine what must be done to achieve each set. The results of this planning are illustrated in Figure 2, Section I. To achieve cleaner water, additional monies must be spent for construction and operation of municipal wastewater treatment plants and for management of nonpoint sources of pollution such as urban stormwater runoff and agricultural runoff. The cost/benefit trade-offs will be submitted to public review and comment. A level of water quality will be selected based on the local desires for clean water, as well as willingness and ability to pay for the cleanup.

The selected plans, along with the resulting water quality, will then be recommended to the Texas Water Quality Board (TWQB). If the plan's recommendations are certified by the TWQB, they become the official policy of the State of Texas.

Ranges of Water Quality to be Studied in 208

All of the various water pollutants and criteria that were presented in Section II of this report will be considered in the 208 program. However, many of them will be treated only superficially during this planning program due to insufficient data or inadequate techniques to predict and assess their quantities and effects. Therefore, the 208 program will be primarily planning for the following measures of water quality.

1. Dissolved Oxygen -- necessary for protection and propagation of fish, shellfish, and wildlife. Low dissolved oxygen in a stream indicates the presence of decomposing organic matter (e.g., domestic sewage).

2. Fecal Coliform Bacteria -- an indicator of the presence of harmful bacteria and viruses. Low fecal coliform counts are necessary for water suitable for contact recreation or domestic water supply use.

3. Suspended Solids -- high concentrations of suspended solids cause the streams to be brown and murky. These solids will be deposited in lakes, along stream beds, and in drainage-ways, thereby smothering bottom dwelling organisms and requiring costly maintenance dredging.

The above measures of water quality were chosen for use in the 208 program because of the following facts:

1. The TWQB is currently preparing mathematical models which simulate the response of Houston area streams to the introduction of organic matter (BOD), dissolved oxygen, and fecal coliforms.

2. The TWQB routinely writes permits for waste discharges which restrict the discharge of suspended solids and organic matter (BOD), which consumes dissolved oxygen. Some industrial permits restrict discharge of other materials (e.g., heavy metals, pH), and some domestic wastewater treatment plant permits restrict discharge of nutrients (e.g., nitrogen and phosphorus) and fecal coliform bacteria.

3. There are currently inadequate techniques available for the simulation of nutrients (e.g., nitrogen and phosphorus) in area streams.

4. The TWQB currently sets standards for: chlorides, sulfates, total dissolved solids, dissolved oxygen, pH, fecal coliforms and temperature for fresh waters; and dissolved oxygen, pH, fecal coliforms, and temperature in salt or brackish waters.

Table 4 illustrates the Alternative Water Quality Standards to be considered in the Greater Houston Area 208 Program. The table lists both water use criteria and numerical criteria.

The water uses criteria are the uses currently deemed desirable for each specific surface water body. These criteria are:

Non-contact Recreation Waters -- surface waters which are suitable for human recreation activities which do not involve significant risk of ingestion (e.g., boating, fishing). Fecal coliform counts should be less than 2,000 MPN/100 ml.

Contact Recreation Waters -- surface waters which are suitable for recreation activities which involve human bodily contact (e.g., swimming, wading, water-skiing) where ingesting the water is possible. Fecal coliform counts should be less than 200 MPN/100 ml.

Domestic Raw Water Supply -- surface waters which could be effectively treated to produce water suitable for human consumption with no significant health hazard. Fecal coliform content should be less than 20 MPN/100 ml.

Propagation of Fish and Wildlife -- Surface waters which are suitable to support the propagation of finfish, shellfish, and the wildlife dependent on the aquatic organisms for food supply. Dissolved oxygen content should be greater than 4.0 mg/l with a range of 5-6 mg/l desirable for great diversity in the biological community.

The numerical criteria are the actual measures of water quality that apply to each stream in the 208 area. The specific numerical criteria in the following tables are:

Dissolved Oxygen -- The value for dissolved oxygen in the table is the minimum concentration of oxygen in the stream for any day during the year. That is, the dissolved oxygen should never be less than the standard for more than eight hours during any 24-hour period (allowing for a variation of not more than 1.0 mg/l due to oxygen uptake by aquatic plant respiration). A dissolved oxygen content of 6 mg/l will support a diverse biological community, 5 mg/l will support most fish and aquatic organisms, below 4 mg/l the diversity of the biological community decreases rapidly.

Fecal Coliform Bacteria -- The values shown for counts of fecal coliform bacteria is the logarithmic mean of the number of bacteria which would likely be found in 100 ml of water during a year. (That is, the logarithmic average of all counts in a one-year period.) Fewer than 20 MPN/100 ml is desirable for raw domestic water supply and shellfish areas, fewer than 200 MPN/100 ml is desirable for contact recreation, fewer than 2,000 MPN/100 ml is desirable for non-contact recreation areas.

How Were The Planning Standards Adopted and How Will They Be Used?

The standards presented in Table 4 were adopted subsequent to workshops and meetings held during the month of January 1977. The 208 advisory committees, Areawide Planning Advisory Committee, Technical Advisory Committee, and Citizen's Advisory Group, have reviewed these standards.

The workshops and review process sought comments with regard to which bodies of water should have set standards, what uses would be desirable for these water bodies, as well as suggestions as to specific numerical criteria and additional measurement parameters. The planning standards as presented in Table 4 have been transmitted to the consultants developing the alternative technical subplans.

The technical consultants have begun to develop the pollution control strategies that must be implemented to achieve each level of stream quality. This will be generally accomplished in the following manner:

1. The discharges of pollutants into area streams will be projected into the future (20 years) assuming no changes in treatment or pollution control.
2. The streams receiving these wastes will be modeled to simulate the effects of these pollutant inflows.
3. The model will predict the dissolved oxygen concentration, fecal coliform count, and suspended solids concentration in the streams.
4. If none of the water quality standards are violated, then no changes are necessary. However, if any of the standards are violated, techniques and strategies must be proposed to reduce the amount of pollutants introduced into the stream.
5. The reduced discharges are then put into the stream models to determine the effects on the stream. This process should be continued until no planning standards are violated.
6. The resulting plans will include alternative methods of reaching each level of stream quality and will be submitted to public review and comment.
7. One technical plan for controlling pollutants will then be selected and will thus indicate a level of water quality that can be achieved. This final set of water quality standards will then be recommended to the Texas Water Quality Board for adoption.

TABLE 4

ALTERNATIVE WATER QUALITY STANDARDS FOR CONSIDERATION IN THE GREATER HOUSTON AREA 208 PROGRAM

		WATER USE CRITERIA				NUMERICAL CRITERIA**	
STREAM SEGMENT	ALTERNATIVES*	NON CONTACT RECREATION	CONTACT RECREATION	FISH/ WILDLIFE	WATER SUPPLY	OXYGEN mg/1 (NOT LESS THAN)	FECAL COLIFORM MPN/100 ml (NOT MORE THAN)
1001 - San Jacinto River Tidal Portion	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
1002 - Lake Houston	A	Yes	Yes	Yes	Yes	5.0	200
	B	Yes	Yes	Yes	Yes	5.0	20
1003 - East Fork- San Jacinto River	A	Yes	No	Yes	Yes	5.0	2,000
	B	Yes	Yes	Yes	Yes	5.0	200
1004 - West Fork- San Jacinto River	A	Yes	Yes	Yes	Yes	5.0	200
	B	Yes	Yes	Yes	Yes	5.0	200
1005 - Houston Ship Channel Lower	A	Yes	No	Yes	No	4.0	1,000
	B	Yes	Yes	Yes	No	5.0	200
1006 - Houston Ship Channel Upper	A	No	No	No	No	2.0 3.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
1007 - Houston Ship Channel Turning Basin	A	No	No	No	No	1.5 3.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
1008 - Spring Creek	A	Yes	No	Yes	Yes	5.0	2,000
	B	Yes	Yes	Yes	Yes	5.0	200
1009 - Cypress Creek	A	Yes	No	Yes	Yes	5.0	2,000
	B	Yes	Yes	Yes	Yes	5.0	200
1101 - Clear Creek Tidal	A	Yes	No	Yes	No	4.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
1102 - Clear Creek Above Tidal	A	Yes	No	Yes	No	5.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
1103 - Dickinson Bayou Tidal	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
1104 - Dickinson Bayou Above Tidal	A	Yes	No	Yes	No	5.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
2425 - Clear Lake	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
2426 - Tabbs Bay	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
2427 - San Jacinto Bay	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
2428 - Black Duck Bay	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
2429 - Scott Bay	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
2430 - Burnett Bay	A	Yes	Yes	Yes	No	4.0	200
	B	Yes	Yes	Yes	No	5.0	200
Vince Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Armand Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Buffalo Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Sims Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Greens/Halls Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Brays Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Hunting Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
White Oak	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200
Carpenters Bayou	A	Yes	No	No	No	2.0	2,000
	B	Yes	Yes	Yes	No	5.0	200

* A third alternative will be considered. This technology option will assume that current effluent limitations (1977) will remain, and the resultant stream quality will be determined.

** No stream standards will be set for suspended solids. Control strategies will be analyzed for various load reductions on streams where suspended solids have a significant impact on the stream.

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